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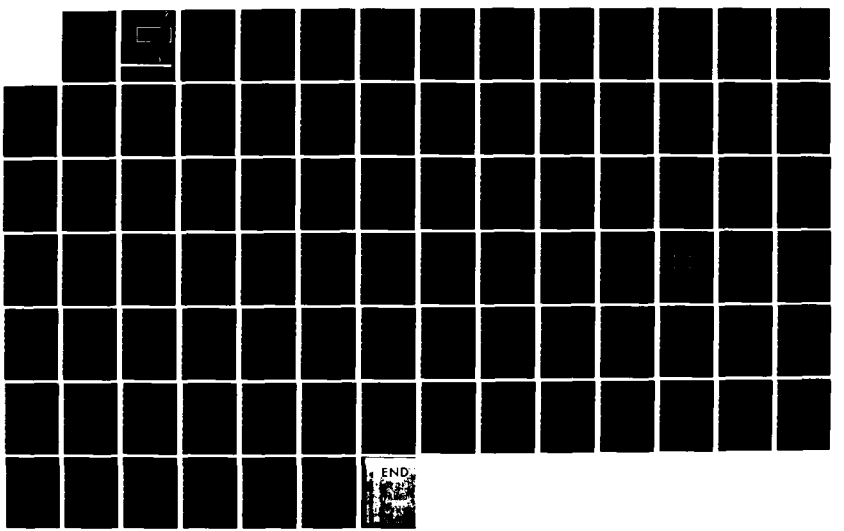

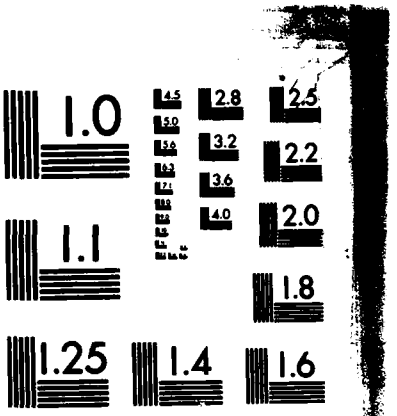

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FINAL REPORT
TRADOC RAM DATA EVALUATION SYSTEM (TRADES)
(ACN 51235)

PART IV: ALTERNATIVE CONCEPTS OF OPERATION

APJ 892-5

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APJ 892-5

FINAL REPORT
TRADOC RAM DATA EVALUATION SYSTEM (TRADES)
(ACN 51235)

PART IV: ALTERNATIVE CONCEPTS OF OPERATION

UNDER

CONTRACT NO. DAAK21-81-C-0034

FOR

RAM ENGINEERING AND ASSESSMENT BRANCH
RAM/ILS DIVISION
MATERIEL SYSTEMS DIRECTORATE
U.S. ARMY LOGISTICS CENTER
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TRADOC RAM Data Evaluation System

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The TRADES final report provides an innovative concept for the collection, evaluation, storage, and dissemination of reliability, availability, and maintainability data to satisfy TRADOC requirements. The five part study recommends an automated system that enables the TRADOC combat developer to access RAM information from appropriate data sources. Combat and materiel developers need such a system to utilize and draw maximum actionable inferences from existing and future data bases.

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Part I: Executive Summary. Includes the highlights of the study effort, detailing the background which led to the study, the essential areas of analysis, alternatives developed, study conclusions and recommendations.

Part II: Study Work Plan (SWP). The SWP outlines the objectives of the TRADES concept development, the purpose, assumptions, scope, essential elements of analysis, time schedule, and rescurces required for the study.

Part III: System Requirements Description (SRD). The SRD presents the functional requirements for the TRADES system developed using basic source documents, questionnaires, and dialogue established with data users, data proponents, and data sources.

Part IV: Alternative Concepts of Operation (ACO). The ACO explains the five ACOs which were developed and includes a comparative evaluation of these alternatives along with the recommendation to use the U.S. Army Logistics Center Planning Factors Data Base (PFDB) mini-computer.

Part V: System Technical Paper (STP). The STP documents the data system concept which includes the overall concept of operation, internal and external procedures, hardware and software requirements, and personnel implications. This report also recommends that TRADES capitalize on the currently available and programmed hardware within TRADOC, which significantly reduces implementation costs and time.

NOTICE

VIEWS, OPINIONS, AND/OR FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF THE AUTHOR(S) AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION, POLICY, OR DECISION UNLESS SO DESIGNATED BY OTHER DOCUMENTATION.

FOREWORD

This report entitled "TRADOC RAM Data Evaluation System (TRADES)" is an American Power Jet Company (APJ) study effort issued in five parts:

Part I:	Executive Summary and Brief
Part II:	Study Work Plan
Part III:	System Requirements Description
Part IV:	Alternative Concepts of Operation (This Report)
Part V:	System Technical Paper

This Part of the final report explains the five ACOs which were developed, and includes a comparative evaluation of these alternatives along with the recommendation to use the U.S. Army Logistics Center Planning Factors Data Base (PFDB) mini-computer.

A draft version was submitted as APJ 892-3, and presented to the SAG. Their comments and recommendations are incorporated herein and are gratefully acknowledged.

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CHAPTER I

INTRODUCTION

SYSTEM TITLE

The title of this study is the "TRADOC RAM Data Evaluation System (TRADES) (ACN 51235): Phase II".

References made to the acronym "TRADES" throughout this report will refer to the TRADOC RAM Data Evaluation System and not to the present study.

SUBJECT OF THIS REPORT

This report, entitled "Alternative Concepts of Operation (ACO)" addresses the third task in a series by the American Power Jet Company (APJ) for the U.S. Army Logistics Center. Two previous reports covered the development of the Study Work Plan (SWP) and the System Requirements Description (SRD). This ACO report will be followed by the System Technical Paper (STP) and the Final Study Report (FSR), which will incorporate all the previous reports. A more detailed description of each task is provided in the SWP and SRD.

BACKGROUND

The need for TRADES has evolved due to the ever-increasing complexity of weapons systems and the need for the combat developer to establish standards to ensure that these expensive systems will work when fielded. Realistic RAM parameters and thresholds must be prescribed which are based on user needs for system effectiveness and logistics supportability in view of system design, state-of-the-art technology, and performance achieved by fielded equipment. Great care must be taken in establishing RAM requirements because of their significant effect on development and operating and support costs, and on equipment readiness.

TRADES is envisioned as an information system which would provide the TRADOC combat developer with responsive near real-time automated reliability, availability, and maintainability (RAM) information. This would include engineering, test, and field data, and would provide the capability to support requirements determination and test analyses for materiel under development. A complete summary of TRADES and its background is included in the SRD.

PHASES

The TRADES study effort has three phases: Phase I established the requirement for a TRADES system; Phase II (the current phase) in essence portrays the concept for TRADES; Phase III, if approved, will address the implementation of TRADES as an operating system for the TRADOC community. It should also be noted that, although the system is being developed for TRADOC, other potential users in the Army have been identified.

PURPOSE OF THE ACO STUDY

The purpose of the ACO study is to evaluate four ACOs for TRADES, recommend a preferred alternative to the Study Advisory Group (SAG), and provide the vehicle to enable the SAG to select the best course of action for STP development.

The Statement of Work (SOW) and guidance from the SAG requires a consideration of concepts which would:

1. merge the TRADES function into the USALOGC Planning Factors Data Base (PFDB)
2. merge TRADES into the USALOGC Maintenance Task Demand (MTD) file
3. merge TRADES into the Automatic Data Processing Equipment (ADPE) concept
4. be selected by the contractor.

These four concepts were briefed in general terms at the previous SAG and are presented in detail herein. Each concept description includes the overall concept of operation, organizational elements, procedural description, and automatic data processing equipment (ADPE) hardware and software.

SCOPE AND SUMMARY OF CHAPTERS

The SRD covering the TRADES requirement conceptual structure of systems satisfying that requirement was completed in July 1981, and was approved with minor corrections by the TRADES SAG in August 1981. The present report provides four ACOs which will be described in detail and analyzed, and will recommend the best alternative concept to implement TRADES.

Chapter I (Introduction) provides the background to TRADES and to this report.

Chapter II (Methodology) describes the methods used to determine the facts leading to the description of the ACO alternatives and the recommended alternative.

It also includes a general description of the overall TRADES concept which the four ACOs will address. (This insures equal capabilities for each ACO described in Chapters IV, V and VI below.)

Chapter III (Evaluation Criteria) establishes the criteria used for comparison and evaluation of the four ACOs. These criteria were reflected in the SWP and further detailed in the SRD.

Chapters IV, V, VI and VII present and discuss four ACOs (PFDB, MTD, and ADPE, and the Stand-Alone Alternative developed by APJ). These four alternatives are presented in terms of organizational, procedural, and ADPE requirements.

Chapter VIII (Analysis of Alternatives) uses the evaluation criteria discussed in Chapter III to compare the four alternatives described in Chapters IV, V, VI, and VII. The advantages and disadvantages of each alternative are portrayed and discussed, to enable the reader to understand the different operating environments and procedures for each ACO.

Chapter IX (Conclusions) summarizes significant findings of the analyses conducted in the preceding chapters.

Chapter X (Recommendations) contains APJ's recommendation of the ACO to be selected for TRADES.

CHAPTER II

METHODOLOGY AND APPLICATION

GENERAL

In general terms, a comparative analysis may be conducted in two ways. One method holds the required capabilities of the alternative roughly equal (cetera paribus), and measures the differing costs. The second method considers a fixed level of resources, and measures the resultant product of each alternative under consideration.

For this study, the first method is considered more appropriate since it is clear that the requirements portrayed in the SRD must be met for any system selected to perform the TRADES function. Figure 2-1 shows the methodology map, which leads to the recommendation of the preferred alternative.

Thus, this chapter establishes the functional and organizational requirements to which each ACO must be designed. It sets forth all characteristics of TRADES which must be common across all ACOs to be considered of "equivalent capability".

ESSENTIAL ELEMENTS OF ANALYSIS (EEA) RELATIONSHIPS

From the concept of equal capability, it can be seen upon examination of the EEAs, that of all factors used in the analysis, the methodology will produce significant differences in primarily two areas: (1) Resource Requirements and (2) Implementation Time. Therefore, conclusions and recommendations resulting from this study are based primarily on the findings from these two areas. These relationships are graphically shown in Figure 2-2.

TRADES LIFE CYCLE OVERVIEW

In accordance with AR 18-1 and TB 18-100, TRADES life cycle is comprised of five major phases in relationship to the management milestones. (See Table 2-1.)

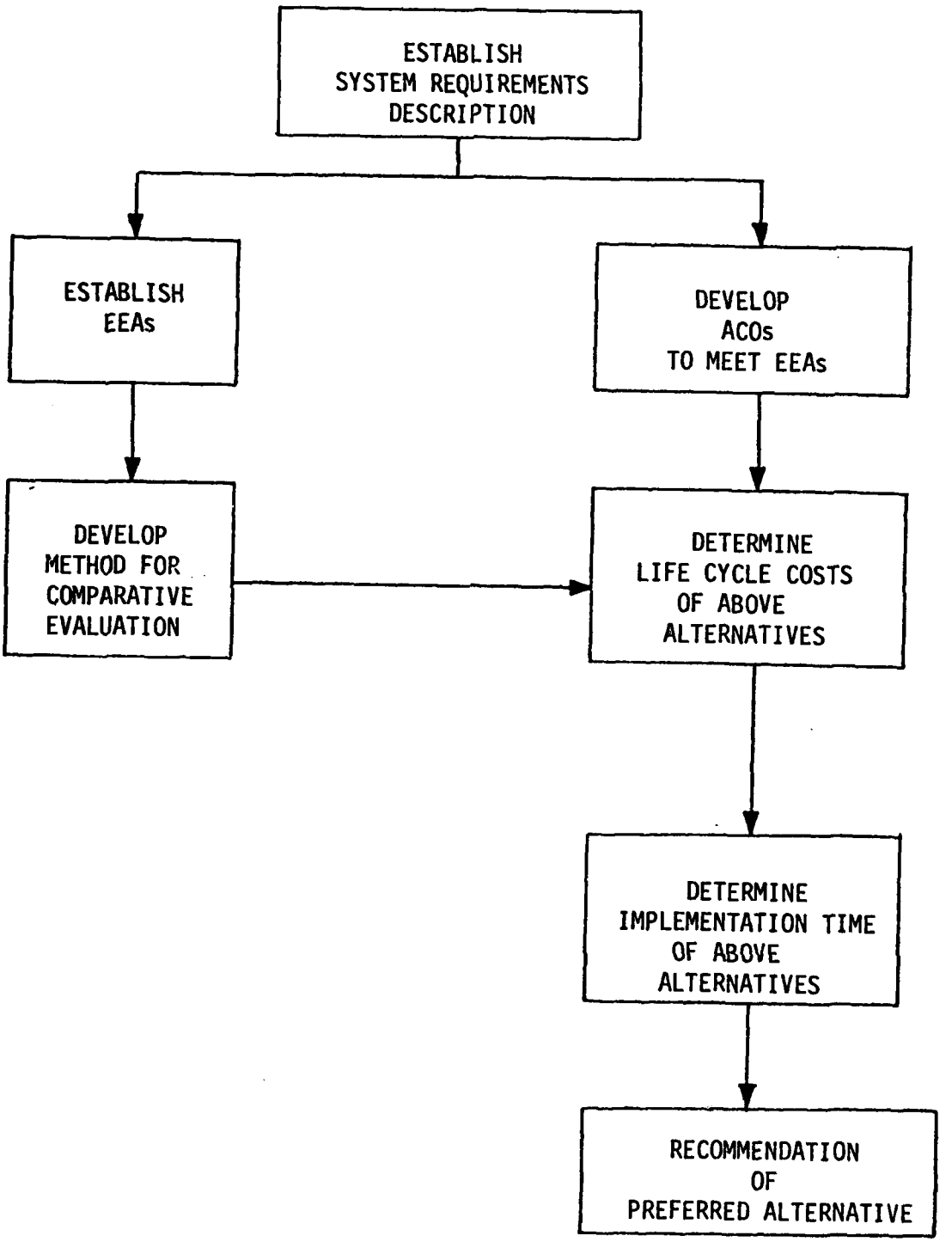

Figure 2-1. TRADES Methodology Map

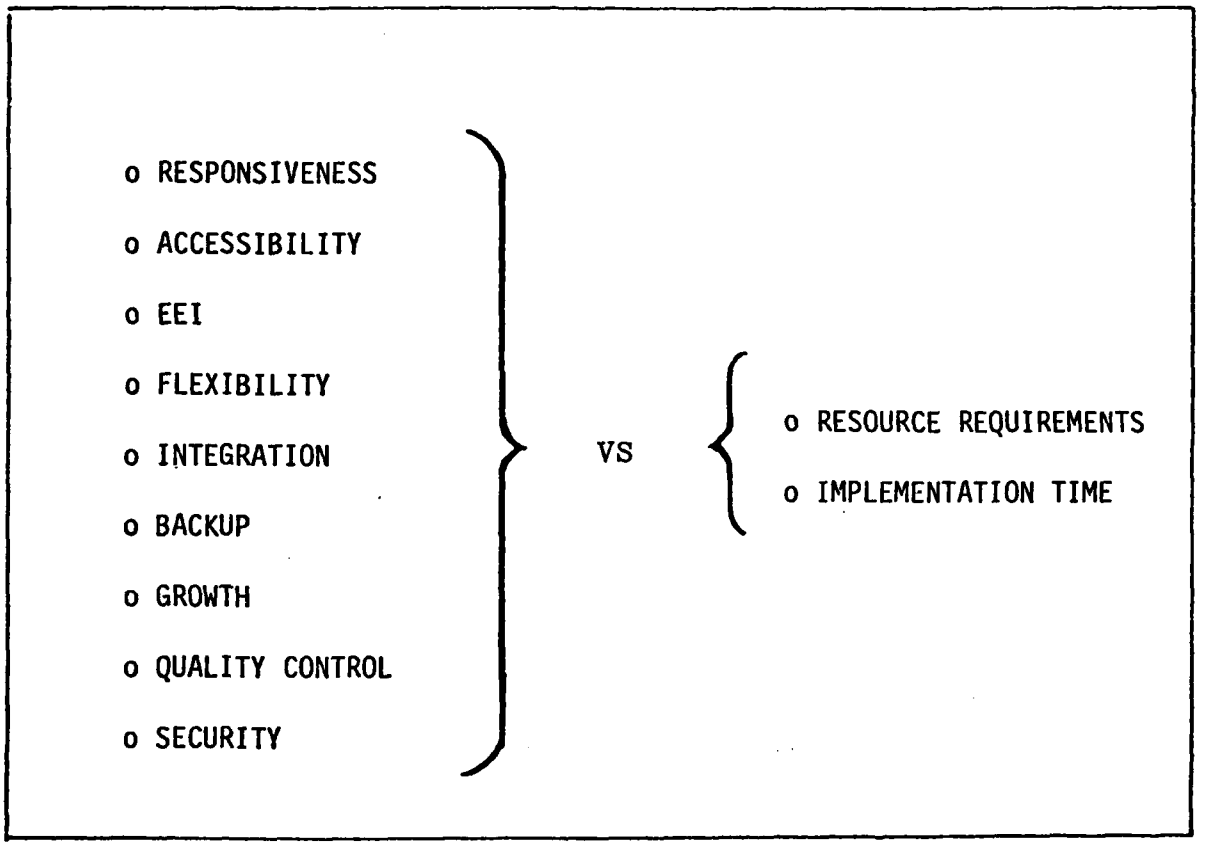

Figure 2-2. Relationship of Essential Elements of Analysis

TABLE 2-1. PHASE/MILESTONE RELATIONSHIPS

PHASE	MILESTONE
I - Feasibility Studies	0 - Approval of MENS
II - Concept Development	I - Selection of Concept to be Demonstrated
III - Definition/Design	II - Decision to Develop System
IV - System Development	III - Decision to Deploy System
V - Deployment/Operation	

As shown in Table 2-2, Phase I (Feasibility Study) has been completed. TRADES is now in concept development with the present effort developing and evaluating ACOs. The final product of this phase will be the development and selection of the final concept (corresponding to Milestone I), with the description presented in an STP.

The next phase of the work program will concern the definition and design of the accepted TRADES system prior to Milestone II. A major initial effort in Phase III will be the organization of the data base, and development of the appropriate taxonomy to facilitate RAM data searches, and to provide for efficient and effective categorization of the data base. The organization of the data base and development of the taxonomy will provide major inputs to the actual design of the system to complete Phase III.

Phase IV consists of the TRADES system development, with the initial effort in prototyping the system prior to Milestone III.

TABLE 2-2. TRADES LIFE CYCLE OVERVIEW

PHASE	FEASIBILITY I	CONCEPT DEVEL. II	DEFINITION/ DESIGN III	SYSTEM DEVEL. IV	DEPLOYMENT OPERATION V	MATURE SYSTEM
Function	Need Determination	ACO Eval'n.	Info. Organiz'n. System Design	Program Debug Proto-type	Initial Use Full Scale Implem'n.	Update Modif'ns. PIP
Status	Completed	In-Progr.	NEXT STEPS →			

As discussed elsewhere, this prototyping could address a single data source as an initiation point for debugging the system, and then progress into full-scale implementation of total RAM data sources. This implementation would then develop into Phase V, the actual deployment and operation of TRADES.

Although TRADES will not likely require DA level approval (developmental costs are anticipated to be less than $3M), AR 18-1 functions as an umbrella over

all Army automation management. Therefore, the provisions of this regulation must be recognized, and recommendations for TRADES are within the perimeters of this regulation.

TRADES SYSTEM CONCEPT ORGANIZATION

To ensure that the ACOs considered in this program provide equal capability, general TRADES characteristics and organization are set forth below. Inherent differences among the ACOs are based on the method by which the program organization can be implemented, and the time and resource requirements of each.

The basic TRADES system concept includes five modules which are controlled by a master TRADES executive program. These modules (shown in Figure 2-3) include:

1. Source Identification
2. Interface
3. Quick Response
4. Statistical/Analytical
5. Management.

Source Identification Module

This module is the basic vehicle by which RAM data users can query a central repository for all sources of appropriate RAM data. It contains a logical organization or taxonomy of all commodities of interest to RAM data users, to the commodity, end item, major system, or subsystem levels. Selected components may also be entered as required. This module will provide the user with:

1. Agency and/or activity with appropriate RAM data holdings
2. Form of data (hard copy, automated unclassified and/or secure data bases)
3. Extent of holdings (years of information, number of test reports, total number of records, etc.)
4. Form of data (test reports, raw field data, reduced data, analysis results, etc.)
5. Environmental conditions (e.g., peacetime vs combat, geographical area, arctic vs tropical, desert vs cultivated areas, etc.)

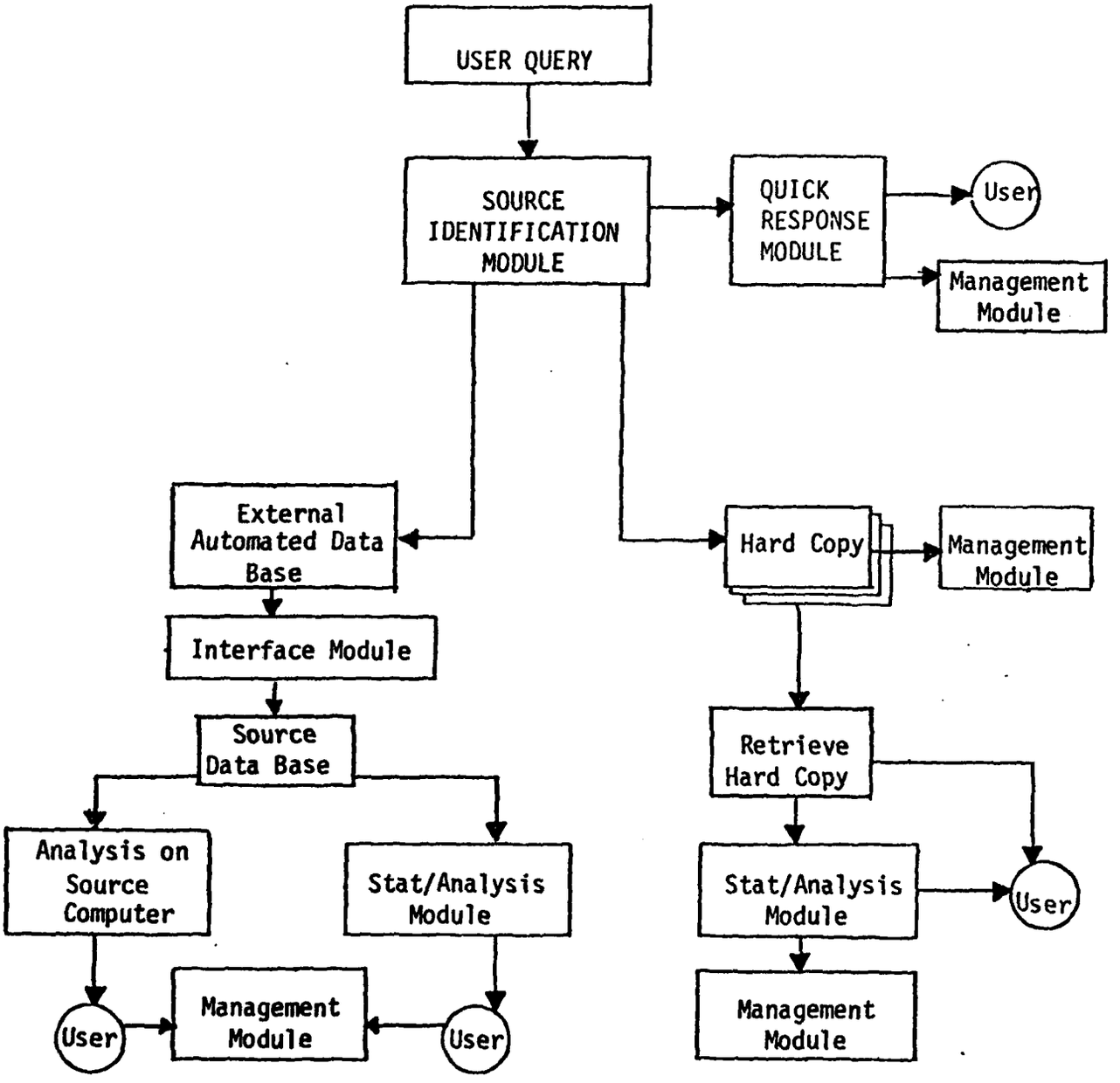

Figure 2-3. TRADES Request Flow

6. Point of contact
7. If automated data base:
   a. Accessibility through user terminal
   b. Necessary passwords, machine interface, baud rate, etc.
   c. Protocol and procedures for obtaining data.

In the event that an automated data source is identified in query, this module will provide complete description of file layouts (essential elements of information (EEIs) in each field of data), together with necessary identification and definition of terminology to provide the user with information relative to user requirements which may be matched by the data base.

Interface Module

This module contains the necessary protocol to communicate with the diverse computers which may contain RAM data bases within DA (or other military services, as required). Access to the interface module is indicated from the source identification module, depending on the specific user requirements and source identification. To the extent feasible, this module should also contain adequate software to provide the user with a basic vehicle for extracting, analyzing, and formating outputs from automated data sources.

Quick Response Module

This module provides an immediate "acceptable" value for each EEI as they refer to all items in the taxonomy. These values are provided and controlled by individual proponent activities that are authorized to enter a "preferred" value for given commodity elements. This module would be highly dynamic since values are entered into the quick response portion as user requirements arise. System RAM requirements along with OMS/MP from the ROC will be entered in the Quick Response Module.

Statistical/Analytical Module

All tools necessary for RAM data users to extract data, formulate tables, carry out regressions or time series analyses, and other statistical/analytical procedures with minimal manual effort are provided by this module. It could contain readily available software packages.

Management Module

This module serves two basic functions:

1. Development of historical information for management purposes
2. Automated system for establishing a RAM "corporate memory".

For proper management of the TRADES system, this module will include historical information of all transactions including:

1. Who used the system and how often
2. What EEIs were requested
3. Level of data required (commodity area, end item, major subsystem, etc.)
4. Frequency of response indicating hard copy only
5. Frequency of use of automated data bases by activity
6. Number of times quick response file was used
7. Utilization of statistical/analysis module
8. Necessary administrative information required for budgeting, etc.

The management module, as shown in Figure 2-4, provides the basic vehicle for adding, deleting and/or changing EEIs, taxonomy, software, and other characteristics of the overall TRADES data system.

For its second function (establishing a corporate memory) provision is made for recording significant outputs from any RAM query as they relate to the equipment taxonomy item, environment, life cycle stage, and date of query. It can also be used by the commodity proponents to make entries or changes to the quick response module.

The decision to place the "corporate memory" of RAM analysis results in the management module was made primarily on the basis that the corporate memory is not, as such, subject to change. This is in contrast to the quick response and source identification modules which are subject to continuing update and which together represent the best available information at any given point in time. Nevertheless, this subject will be further examined during the preparation of the STP, where it may be found that programming convenience, coupled with properly designed access/modification controls may permit its placement in another portion of the implementation structure.

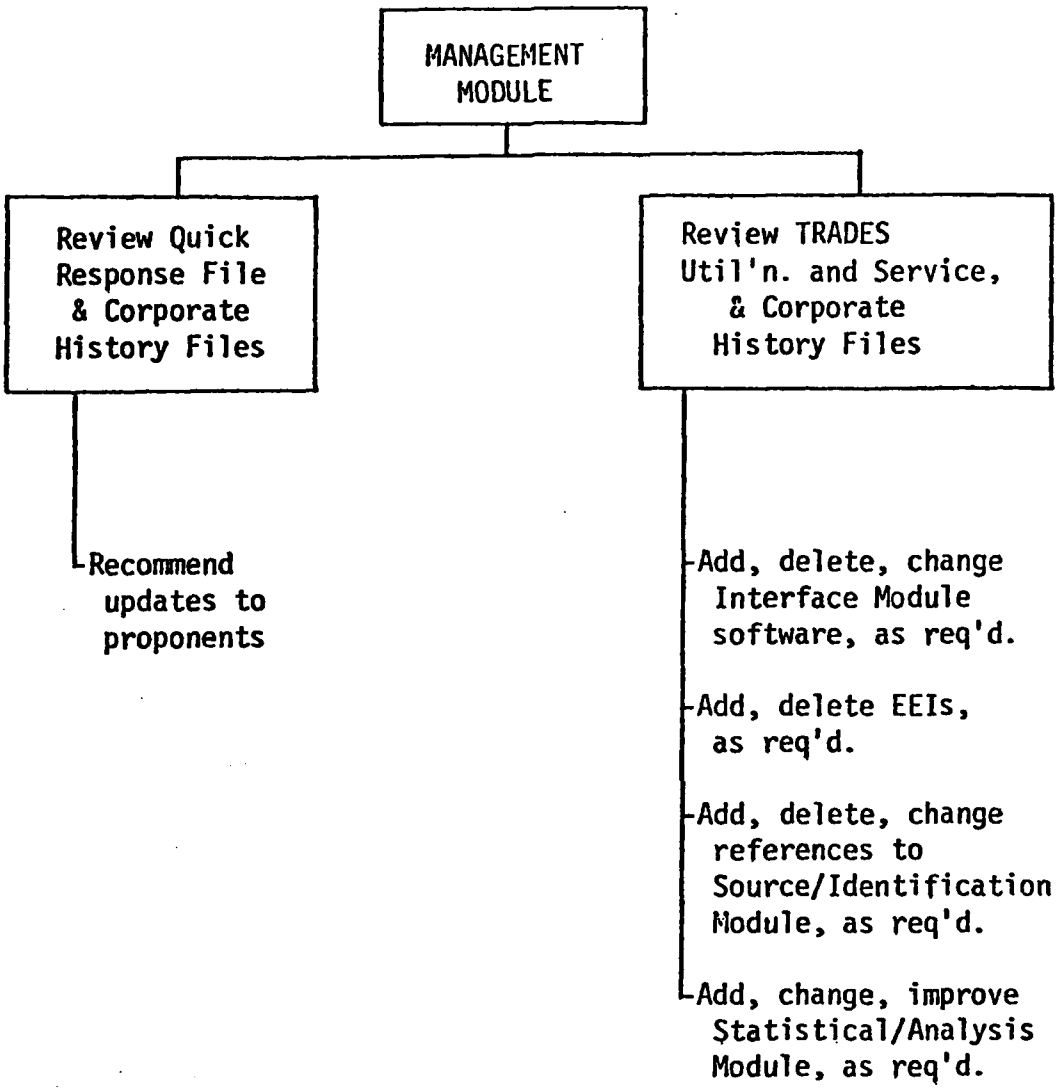

Figure 2-4. TRADES Management Functions

SYSTEM DEVELOPMENT AND IMPLEMENTATION

An inherent characteristic required of each ACO is that it be capable of being prototyped and permit its evolution in the direction of maximum customer service. This infers that RAM data is not a "once and for all" requirement set by current RAM requirements documents or users, or indeed by the present users' view of what they need. These, to the contrary, are only starting points.

Once TRADES is operational, it must respond to changes and needs of the user community, as well as to increasing availability of RAM data at any point in its life cycle. It must determine weak spots in the source data and use the TRADES system to secure action in areas of maximum return. This implies a highly competent TRADES management team, comprised of human beings using the computer as only one of their tools in meeting their missions and functions.

The ultimate goal of the overall program is to establish a major RAM data system that will satisfy user requirements in minimum response time. It must be recognized, however, that for several years, the system will be operating in a mixed hard copy/lightly automated environment, moving toward a less important hard copy and more important automated data system. In either case, hard copy data must be recognized as being involved in RAM data somewhere in the system at all times.

Figure 2-5 provides a diagram of the TRADES RAM data update routine. Primary responsibility for this function resides with the proponent of the specific item for which the RAM data is being updated. However, basic information necessary for the proponent to exercise its function resides in the management module and history files. Likewise, any actions taken in the update of these source files is recorded in the history files.

TRADES ACO COMMON PROCEDURAL CHARACTERISTICS

The TRADES user procedures for all ACOs are the same and follow a progression of steps in a sequential order. When a requirement for RAM data is identified, the user queries the source identification module in terms of a specific EEI. This can be further delineated by a set of geographical conditions, local environments, and type of data (DT, OT, field data, etc.).

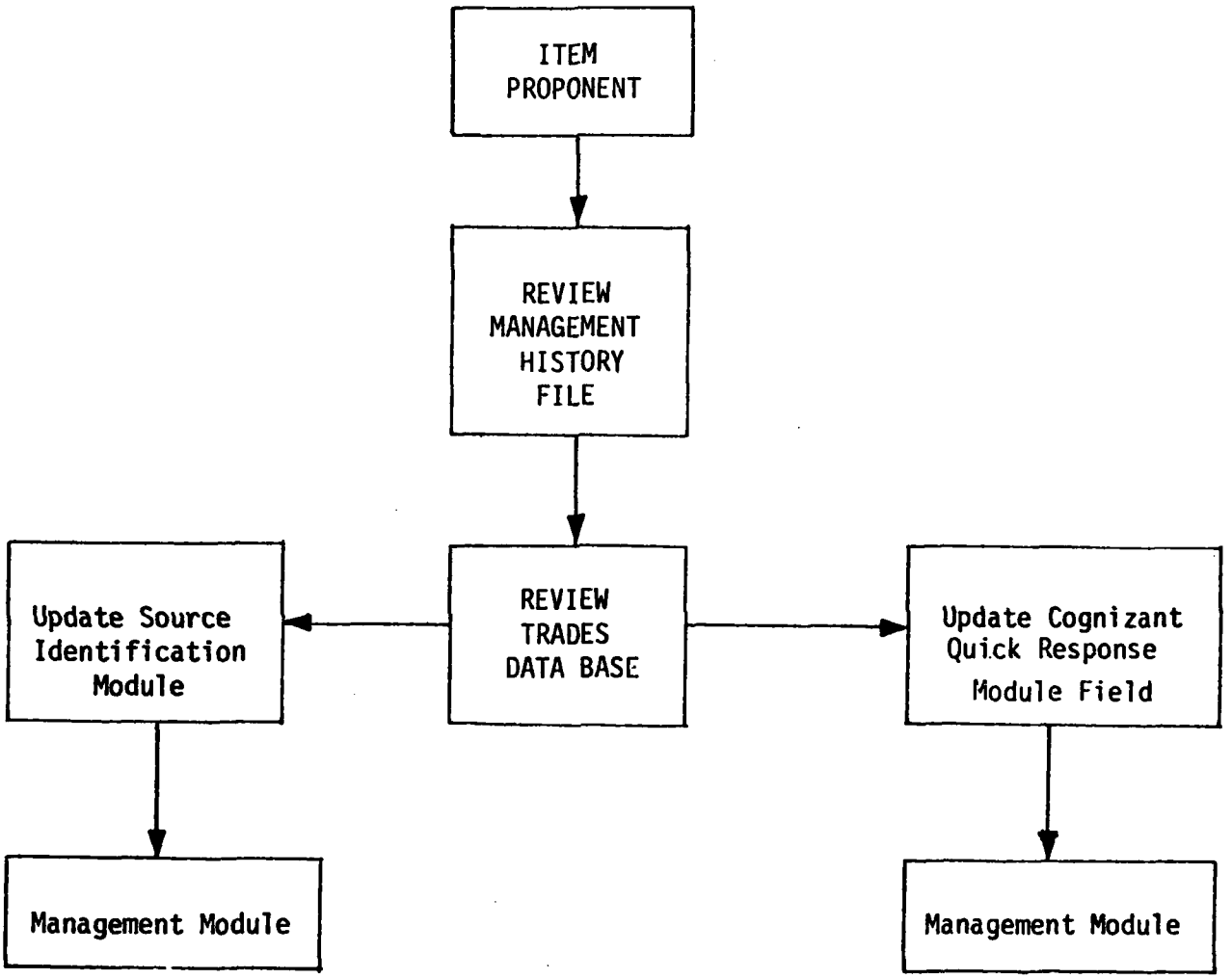

Figure 2-5. TRADES RAM Data Update Routine

Following procedures depend on the response obtained from the source identification module. If data are available in hard copy, arrangements can be made external to TRADES to obtain necessary information.

If the data are on an automated base, the source identification module identifies the availability or accessibility of the data base. If the resident computer software package can provide the necessary output, the interface module is then used to provide the necessary output.

If the data are accessible, but the resident computer cannot provide data in usable form, data is then extracted via the interface modules, stored temporarily in the TRADES computer, and the necessary output provided by the statistical/analytical modules. Output report generation capability is available either in the interface module, or in the statistical/analytical module.

DEVELOPMENT OF CURRENT "HARD COPY" RAM DATA REFERENCES

As noted above, a major portion of the RAM data base (at program initiation) will comprise hard copy test reports. This involves a concept of operation in which a TRADES management office would undertake to identify the hard copy, creating a definitive hard copy data base which is indexed and deposited in an accessible location, subject to security/need-to-know controls on distribution. Such an office could be a TRADES management office (through a separate Data Base Section), or alternatively, DTIC or DLSIE. DTIC has the advantage of being the repository of a large holding of TECOM and OTEA test reports.

Succeeding efforts in the TRADES program should identify holdings of hard copy and develop a format for indexing such reports for direct application to TRADES, and translate selected RAM information to TRADES.

In parallel, TRADOC should issue appropriate instructions to insure that TRADOC agencies retain their information, or forward/make it accessible to the TRADES Office carrying out the development of the source identification module for the TRADES program. These procedures could be made part of a basic Army regulation that establishes TRADES and a TRADES management office (see Recommendations, Chapter X of this report).

A major issue to be resolved common to all ACOs is the disposition to be made of hard copy data. One approach might be to leave it in its present physical location, with provisions (made through military procedures) to keep it from being destroyed until it is no longer useful for RAM analyses. In such a concept, the proponent, data holder or generator, will develop an inventory and advise the user (upon being queried) that he has information of interest.

An alternative would be to maintain a central TRADES repository of all hard copy not formally inventoried in major hard copy data holdings with instructions issued for these holdings to be forwarded to the central repository.

The third concept, as noted, would be to provide current organized data systems (e.g., DTIC/DLSIE) with the opportunity to index and inventory all holdings not currently in their files to make them available to all potential RAM data users on an as required basis. DTIC and/or DLSIE would then become the central repository of all hard copy historical files, as well as new data being generated.

On the basis of the above, the development of the source identification module would include major tasks of:

1. Indexing existing hard copy reports into the TRADES source identification module
2. Providing adequate information for each of the source documents (hard copy reports) that will provide the potential user with adequate information to determine the usefulness of each test report to his requirement.
3. Extract key RAM data and enter it into the TRADES system, thereby reducing response time and narrowing the degree of hard copy search.

A proper taxonomy must be applied to the hard copy to identify the specific commodity, end item, major system or component to which the data are applicable. In parallel, information must be provided as to the EEIs included, environmental or geographical conditions applicable, definition of terminology, etc.

IMPACT OF DRAFT AR 702-3

A review of the most recent draft of the proposed change to AR 702-3 indicates major emphasis on "operational RAM characteristics". The goal of this approach is to establish the effectiveness of the system in an operational environment. This expansion requires incorporation of all personnel and support system considerations in the test programs and evaluation in the test report.

The implications of changes indicated in the proposed AR 702-3 are multi-faceted:

1. A requirement exists to provide the RAM data base with all DT and OT incident reports.
2. Present inherent reliability test results must be properly converted into operational RAM results. Therefore, it is necessary to reconstruct the total test program (by incorporation of incident reports previously not considered associated with inherent characteristics of the equipment).

It is not, however, feasible to rescore all old test reports except on an "as required" basis due to the enormous amount of effort involved in redefining and scoring each test.

Two further requirements of the proposed AR 702-3 changes will directly impact TRADES with regard to this hard copy data base.

TRADOC is assigned the responsibility to "maintain a central activity for the proper statement and justification of RAM characteristics in materiel requirements documents". This is supported by TRADOC development of TRADES.

TRADES will utilize and interface with the materiel developer whose responsibilities are set out as follows:

> "RAM record and audit trail. a. Materiel developers will establish an audit trail to insure traceability of essential RAM effectiveness and support parameters at any time during the materiel system's life cycle in relation to earlier data as well as between program and contractural documents".

The manner in which this requirement is to be implemented by the various materiel developers will depend, to a large extent, on past practices, computer facilities available, the standard test programs. etc.

On this basis, TRADES ACOs must be flexible, have the capacity to absorb the potential magnitude of reports inferred by these requirements, and be able to communicate with those systems used by the materiel developers to establish RAM audit trails. This is particularly important since the results of expanded RAM considerations will not only impact the using and developing agencies, but will also be of direct interest to logistics, personnel and training activities.

Of course, this has much broader implications since these activities may require additional EEIs to satisfy their needs. For example, personnel and training may want information on causes of failures, while support activities may be interested in piece/part identification. All of these factors must be considered in assessing the potential future RAM information that must be absorbed or indexed to TRADES.

DEVELOPMENT OF AUTOMATED RAM DATA REFERENCES

At present, a certain amount of RAM data is being stored in automated data systems. However, with the near implementation of CTDCS and the future consideration of SAMS, increasingly larger portions of RAM data will become available from these automated data systems. Accordingly, each ACO to be evaluated must recognize two potential conditions relative to automated source data bases:

1. RAM data resident on a large-scale computer system with interactive software capability, where a user can select certain data and be provided an analyzed output format.
2. An automated data base which is principally a repository of RAM information with little or no interactive software capability.

If condition 1. prevails, the TRADES interface module should be able to structure specific requirements which can then be processed on a resident computer. The product would be an output report, either hard copy mailed or on-line printed through a high-speed printer, of a product directly usable by RAM engineers.

In condition 2. above, the overall TRADES computer system must have provision for data extraction programs and all of the associated software to process the information into usable form by application of the statistical/analytical module in the TRADES computer. In parallel with this would be the requirement for the TRADES computer to extract the necessary elements of data from the resident data bank and store the information temporarily during the processing. The output would be a direct product of the user via the TRADES terminal, and peripheral high-speed printers.

A third alternative has possible merit when the user has a relatively large capacity computer available. Here, the ACO could make provision to extract relevant data fields from the resident RAM data base, and provide the data elements to the user's computer facility. The user then could develop his own software package for processing and outputting of the data. Likewise, temporary storage of pertinent information for future use is possible.

If a resident data base is considered secure, provision must then be made to preclude the possibility of such data being "pirated". Circumstances which might warrant such consideration would be: (1) if the data might be misinterpreted by potential users, (2) duplication of files is not considered justified inasmuch as the original data base will be available, and (3) the data might be exposed to third parties who, for security or proprietary reasons, are not considered desirable.

IMPLEMENTATION SEQUENCE CONSIDERATIONS

Each ACO will be considered in view of the life cycle of TRADES. They should be capable of having an initiation phase, a growth phase, and a maturity phase. The manner in which the ACOs evolve implies a TRADES management team to control the scope, content, and phasing of operations.

In the initiation phase, consideration could be given to starting:

1. In a given commodity area
2. Across all commodity areas for a given life cycle stage (test data, field data, etc.)
3. A major source or repository of RAM data which could involve one or more commodity groups.

All of the above approaches have their relative merits. However, the most efficient and effective approach appears to be the third -- starting the TRADES program by initiating the source identification module with an agency which is a current major repository of RAM data. In this approach, all phases and/or aspects of TRADES could be initiated on a small scale, and expanded as necessary to include all other data sources on a continuing and gradual basis. It also provides for a gradual program buildup, facilitating debugging not only the program, but the overall TRADES concept by application to selected users on a trial basis.

When the prototype system is operating smoothly, the repository of data sources can be expanded selectively until the total known RAM data source bases have been entered.

During the progress of full implementation, the system can be reviewed to establish any variability to meet users' new requirements. At this point, the system can be considered a fully mature system, capable of meeting the total objectives of the program.

APPLICATION

The description of the TRADES system concept discussed above is considered a requirement of capabilities for each of the ACOs to be developed and evaluated in the remainder of this report. The cost and time implied by each ACO to satisfy the requirements set forth herein constitute the major discriminators leading to the preferred choice.

In what follows, we consider that TRADES is comprised of a functional element and a data processing element. Consideration of the alternative ACOs makes it clear that the potentials of MTD, PFDB, ADPE and Stand-Alone Systems must concern themselves with both the data processing function and the functional responsibilities. Therefore, it is appropriate to describe the overall TRADES in these areas which are clearly inferable from the SRD (Part III) before proceeding to the description discussion of the automation alternatives.

TRADES is seen as comprising the functional integration of source identification, a repository of standardized information in the quick response module, a capability to rapidly manipulate any data obtained, and a

technique for accessing automated data bases. The entirety is unified by a management module which establishes the strategy of TRADES.

Functional Element Staffing

In order to carry out the TRADES function, the functional element is common to all alternatives. We see the functional element as follows:

1. TRADES system management. This entails responsibilities relating to the establishment of the strategy for directing the system, relative emphasis, development of "where TRADES must go" to be of maximum service.
2. Methodological and analysis support. This function relates to being able to make the maximum legitamate and proper inferences from the data and to develop the techniques which are necessary for this purpose. Further responsibilities are to assist the respective users and effect a proper standardization among the methods of the respective users.*
3. Source and user services. This area has to do with source/user services, i.e., the association of the user inquiry with the proper source. It is too much to expect that the entire operation will not require human intervention. This function has been called in other various times and places - "customer service". It is the place where the TRADES system utilizes humans to support inquiries and data searches which are not readily available in the data source module.

*This is a major by-product of the unification which is accomplished through TRADES. By standardizing the statistics and bringing them uniformly to the best possible estimate permitted by the data, the defensibility of the TRADOC product is thereby enhanced.

The following is an estimated functional manning which applies to all alternatives:*

1. TRADES System Manager - 1 Supervisory General Engineer (RAM), GS-13. Qualifications require a broad-based understanding of TRADES, RAM methodology, the Army and its organization. Probable educational background implies significant formal training in statistics/statistical methodology. Approximately six to 10 years of government experience, system management of at least one automated data system, or significant system experience in the planning and organization of such systems.
2. Methodology and Analysis Support - 2 Analysts/Statisticians, GS-13. These personnel are primarily concerned with RAM methodology. A Masters Degree or better is recommended in Mathematics/Statistics, and preferably with a minor or equivalent in Physical Science or Engineering. Also requires three to six years of system analysis involving inferences from data and an ability to handle computers.
3. Source and User Services - 1 Computer Specialist, GS-12, and 1 General Engineer (RAM), GS-11. Positions require a Bachelor Degree, three years of experience and analysis background.
4. One Clerk Typist, GS-04. Functions include some data entry, and should be a "career progression" type job. Work level may ultimately justify two personnel in this area.

In all cases, it is envisioned that the functional personnel would be located in TRADOC integrating centers and schools, test boards, and a coordinating branch in the RAM/ILS Division of the Materiel Systems Directorate

Data Processing Element Staffing

The automation function should consist of the services of Senior Programmers, GS-12, for programming changes and special requirements generated by the RAM analysis/methods support. This would also include programming of special requests developed by the source/user services personnel as well as methodological and analysis section of the functional element.

* This does not consider the personnel and funding resources required in the TRADOC integrating centers, test boards, schools, or other TRADOC supporting elements.

Depending on the degree of sharing service with other activities, the automation function will require an operator, GS-05, to operate the equipment for one shift.

The full or part-time services of a key punch operator, GS-04, is required for the entry of new data as it becomes available.

The data processing element would be assigned to the Computer Support Division of the Operations Analysis Directorate and absorbed as an additional workload on their existing staff. For purposes of this analysis, these personnel are not considered as additional staffing requirements chargeable to TRADES.

A third major function is identifiable. This would be the area of computer management, which concerns itself with computer purchasing, services, maintenance contracts, disposal of unneeded equipment, utilization reporting, economic analyses, and ADP budgeting. This is an inherent function of the Operations Analysis Directorate, and the impact of TRADES would be approximately one-half man-year of management effort.

TRADOC School RAM Office Staffing

Sufficient staffing must be available to perform the added workload presented by TRADES. These functions include, but are not restricted to the following:

1. Provide assistance to the combat developer in using the system.
2. Validate data to be stored in the Quick Response Module.
3. Provide methodology and analysis support to the combat developer.
4. Serve as an interface to other users of TRADES for RAM data.
5. Provide assistance in obtaining hard copy data for locally held RAM data.

CHAPTER III
EVALUATION CRITERIA

GOAL

This chapter discusses the criteria used to conduct the evaluation of the ACOs.

BACKGROUND

The evaluation criteria were carefully selected and incorporated in both the SWP and the SRD provided by APJ. SAG members closely scrutinized these criteria at the SRD meeting held in August 1981, and adopted some changes.

The first change was to break down resource requirements into two categories, Investment and Operating. The second change added the criterion of Implementation Time to the list of EEAs, which in effect, are the criteria to be used for the evaluation of the three ACOs.

The updated EEAs, including changes, are listed in Table 3-1. A discussion of each criterion is provided in the remainder of the chapter.

EEAs

A brief discussion of the EEAs and their relationship to TRADES was provided in Chapter VI of the SRD. They are summarized here for convenience.

Responsiveness to TRADOC User Requirements

The TRADES functional requirements are expressed in terms of:

1. Turnaround Time (TAT) for RAM data
2. Level of RAM data required
3. RAM data form
4. Statistical/analytical manipulation of RAM data
5. Application of standard factors

The same responsiveness requirements will be provided by each ACO. The cost areas impacted by this EEA are primarily in the hardware costs associated with the provision of the RAM data needed within the time and detail established in Chapter VI of the SRD.

TABLE 3-1. ESSENTIAL ELEMENTS OF ANALYSIS (EEA)

1. Responsiveness to TRADOC user requirements
2. Accessibility to proponents
3. Essential Elements of Information
4. Flexibility (batch vs interactive)
5. Integration with other systems
6. Backup capability
7. Growth potential
8. Quality control
9. Security - software and data base
10. Implementation time
11. Resource requirements:
    - Investment
    - Operating

Accessibility to Proponents

The use and availability of a remote terminal is assumed to be required for each alternative. There is a terminal required for each school, with a variation in terminals only with the LOGCEN, based on the alternative being considered. For example, there would be fewer terminals required in the Materiel Systems Directorate if the primary computer were located in that directorate. Primary impact of this EEA is on hardware costs.

Essential Elements of RAM Information

The nine most frequently required EEIs identified in the SRD will be considered a baseline to the system:

1. Mean Time between Failure (MTBF)
2. Mean Time between Operational Mission Failures (MTBOMF)
3. Mean Time between Unscheduled Maintenance Actions (MTBUMA)
4. Probability of mission success
5. Operational Availability
6. Utilization Rates
7. Mean Time to Repair (MTTR)
8. Maintenance Ratio (MR)
9. Administrative Logistic downtime

Flexibility

This discussion of flexibility applies only to system hardware requirements. The topics of operational flexibility and growth potential to include EEI changes, scope and depth of coverage, accessibility, etc. are discussed in conjunction with each of the EEAs.

The wide variety of TRADES requirements makes it mandatory to have an interactive capability between the user and TRADES, and also with other systems, when this is possible. Therefore, batch processing is considered to be a method of processing for routine file update and management information. The major impacts of this requirement will be on hardware and training costs.

Integration with Other Systems

All ACOs meet this capability because an essential function of TRADES is to provide an interface and integration capability with other automated systems. Primary impact is on Resources EEA.

Backup Capability

The backup capability is provided through two means:

1. A TRADES office
2. Use of default values.

The impact is both on hardware costs and personnel (major contributors of the Resources EEA), and these were examined accordingly.

Growth Potential

The requirement for TRADES to assimilate information on more systems and in greater detail, as well as growth in an increasing number and variety of software packages, is clearly articulated in the SRD. The impacts of this area include potential software and hardware considerations, as well as personnel implications. Growth potential includes the ability to:

1. Absorb more and different EEIs
2. Process to piece/part level, if required
3. Be able to process information from future standard Army data systems.

Quality Control

A vital requirement of TRADES is to insure confidence in processed information. This can be accomplished in a variety or combination of ways:

1. Verification of test results
2. Verification of data
3. Parametric design check features
4. Use of trained personnel

Quality control of TRADES can be maintained by:

1. Excellent feedback of information from the user to verify satisfaction of his request
2. Internal checking and auditing, as well as test programs, to insure that minipulations do, in fact, work as advertised.

3. Control (designated) of access to different sectors of information, so that no one can change data in the Quick Response Module or the programs if not previously authorized.

From this list, it can be seen that all areas of resource requirements are affected.

Security of Software and Data Base

Techniques to provide security to TRADES includes personnel, hardware, and software controls. Therefore, all ACOs assumed full use would be made of secure lines, encipherment (as required), and scrambling, as described in the SRD.

Implementation Time

The ACOs have a variable implementation time. For example, it can be assumed that under the PFDB options, development of TRADES would parallel the development time for PFDB. In comparison, work could begin very quickly to modify the MTD.

Resource Requirements

The resources required for the implementation of the ACOs will be a key measure of the advantages of one system over the others. The resources are categorized by software, hardware, and personnel requirements. Where appropriate, investment and operating costs will be shown.

Hardware

Hardware costs will be determined from currently available items from commercial/GSA sources, using normal purchase price and maintenance contracts. Costs are considered for the essential components (terminals, disk or tape drives, storage devices, security devices, communications equipment, printers, and central processing unit).

Software

Software costs are determined primarily by the costs of programming, where appropriate. However, where separately identifiable (e.g., for the purchase of a modern data base management system or analysis programs), these costs will be portrayed.

Facilities

These costs are estimated where it is anticipated that a major modification to existing or planned facilities is required.

Personnel

These costs are based on developmental, training, and operational requirements, within broad estimates. They are based on general planning factors set forth in TB 18-21.

SUMMARY

The methodology portrayed in this chapter provides a process for selection of the recommended course of action. Salient features have been included, which form a baseline for additions or deletions on a selective basis, and for weighting the EEAs, as desired.

CHAPTER IV

PLANNING FACTORS DATA BASE (PFDB) ALTERNATIVE

GENERAL

The objective of the Planning Factors Data Base (PFDB) System is to provide an efficient and accurate means of storing, processing and disseminating approved logistics planning factors and relating data from a central source for use in joint/ unilateral service planning, force development, logistics studies, and reference publications such as FM 101-10-1. These planning factors encompass all classes of supply, maintenance, transportation, services, and facilities.

The PFDB is a proposed system which is being developed by the Planning Factors Management Division (PFMD) of the Operational Analysis Directorate (OAD) at the LOGC. The Detailed Functional System Requirements (DFSR) is anticipated to be completed in the fall of 1981 and fully operational by January 1984. This system is described in more detail in Chapter V of the System Requirements Definition (SRD) report. The PFMD will interface with many organizations throughout the Army and with some organizations of other services. The following organizations are candidates for direct output report dissemination through telecommunications: USAREUR, FORSCOM, all Army corps, CAA, MTMC, ADMINCEN, Aviation School, Quartermaster School, and the Transportation School.

The PFDB may be characterized as a partially distributed automated processing system since it is configured with a dedicated mini-computer (estimated to be the size of a VAX 11/780) linked to a mainframe (eg. DPFO's UNIVAC 1100) both accessible by a number of interactive as well as batch terminals. Central management and control of the planning factors system will be accomplished by the PFMD through the mini-computer. A simplified diagram of the PFDB system configuration is shown in Figure 4-1.

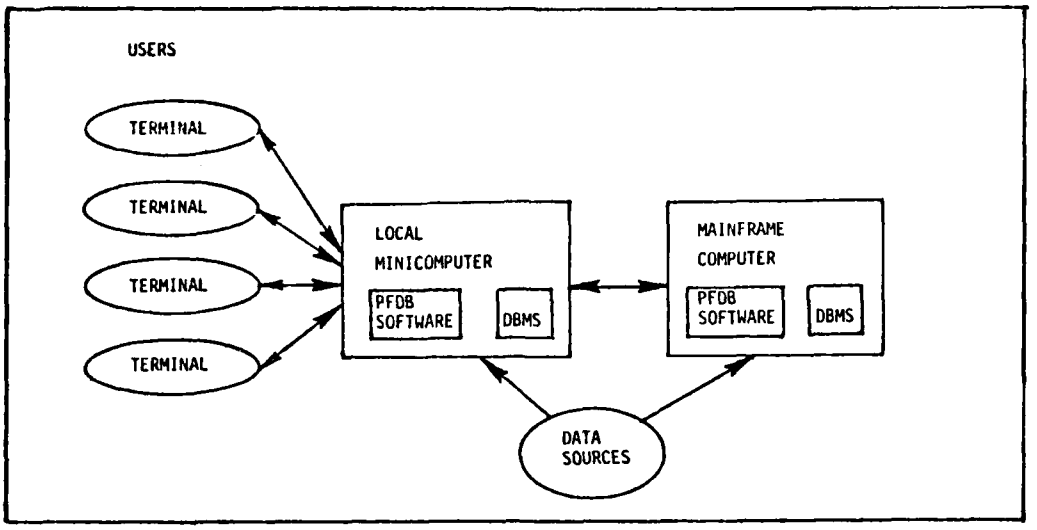

Figure 4-1. Generic PFDB System Configuration

Sources of data are anticipated to be from several existing systems. A list of these are provided below:

1. Asset Composition System (ACS)
2. Structure & Composition System (SACS)
3. The Army Authorization Document System
4. TOE Master Files
5. COMPASS
6. MTD File
7. MACRIT
8. AMDF
9. LSAR
10. SB710-1-1
11. LIF
12. DA Standard Equipment File
13. SB 700-20
14. Sample Data Collection (SDC) File

The MTD File will be integrated into the Planning Factors Data Base System in both hardware and software.

The future PFDB system software will involve four major functions feeding the planning factors data base. These are collection, analysis/development, and validation and storage. Likewise, four essential functions are involved in providing credible output from the data base to users. These are retrieval, development/aggregation, validation and dissemination. A management function is required to assure effective and efficient operation of the other functions. The overall system structure is depicted in Figure 4-2.

The PFDB functions lie in five general areas: data maintenance, user access, management information support, data base administration, and software maintenance.

Four of the five major software processes contributing to the production use of the PFDB (data maintenance, user access, management information, and data base administration), will each have a module associated with the process. Each of these modules depends on a general data base management system.

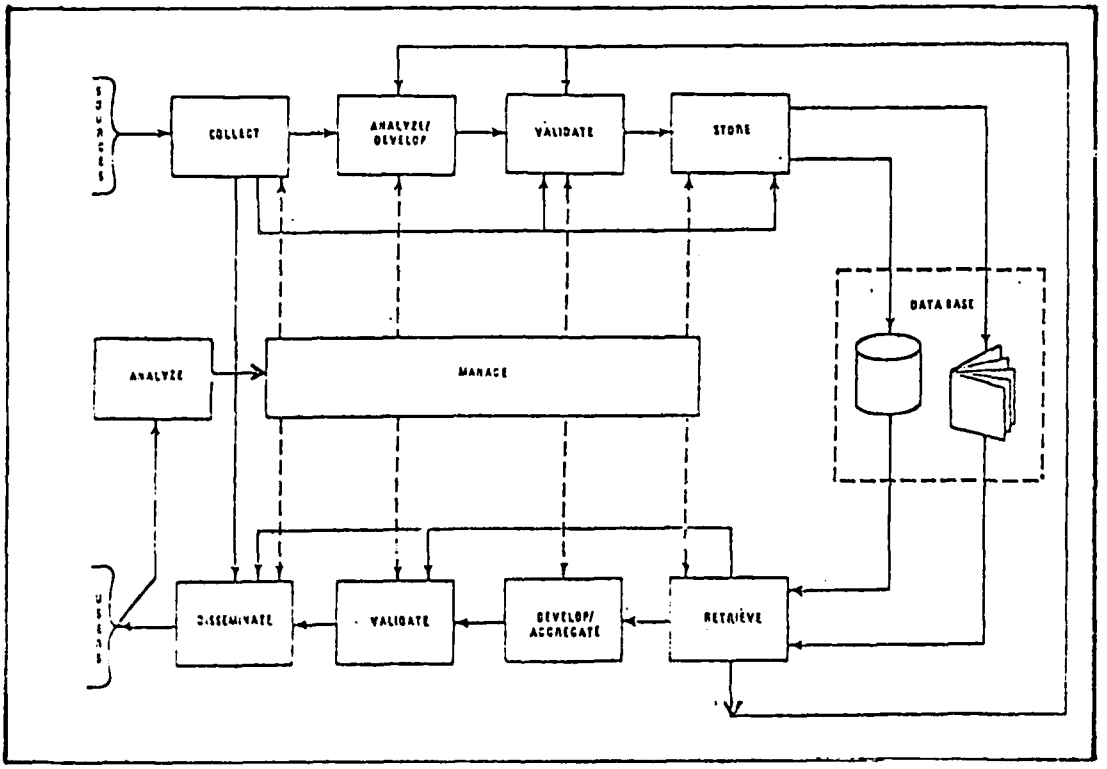

Figure 4-2. Future PFDB System Structure for Software

Figure 4-3 shows the TRADES Alternative Concept of Operation (ACO) using the PFDB System. Significant characteristics of this TRADES ACO are:

1. TRADES will be able to piggy-back onto the PFDB System which is already into the development cycle (with DFSR to be completed shortly, regulation approved, and concept of operation formalized).
2. Development of software for both TRADES and PFMD would be accomplished concurrently to take advantage of commonalities in software, hardware, and data bases.

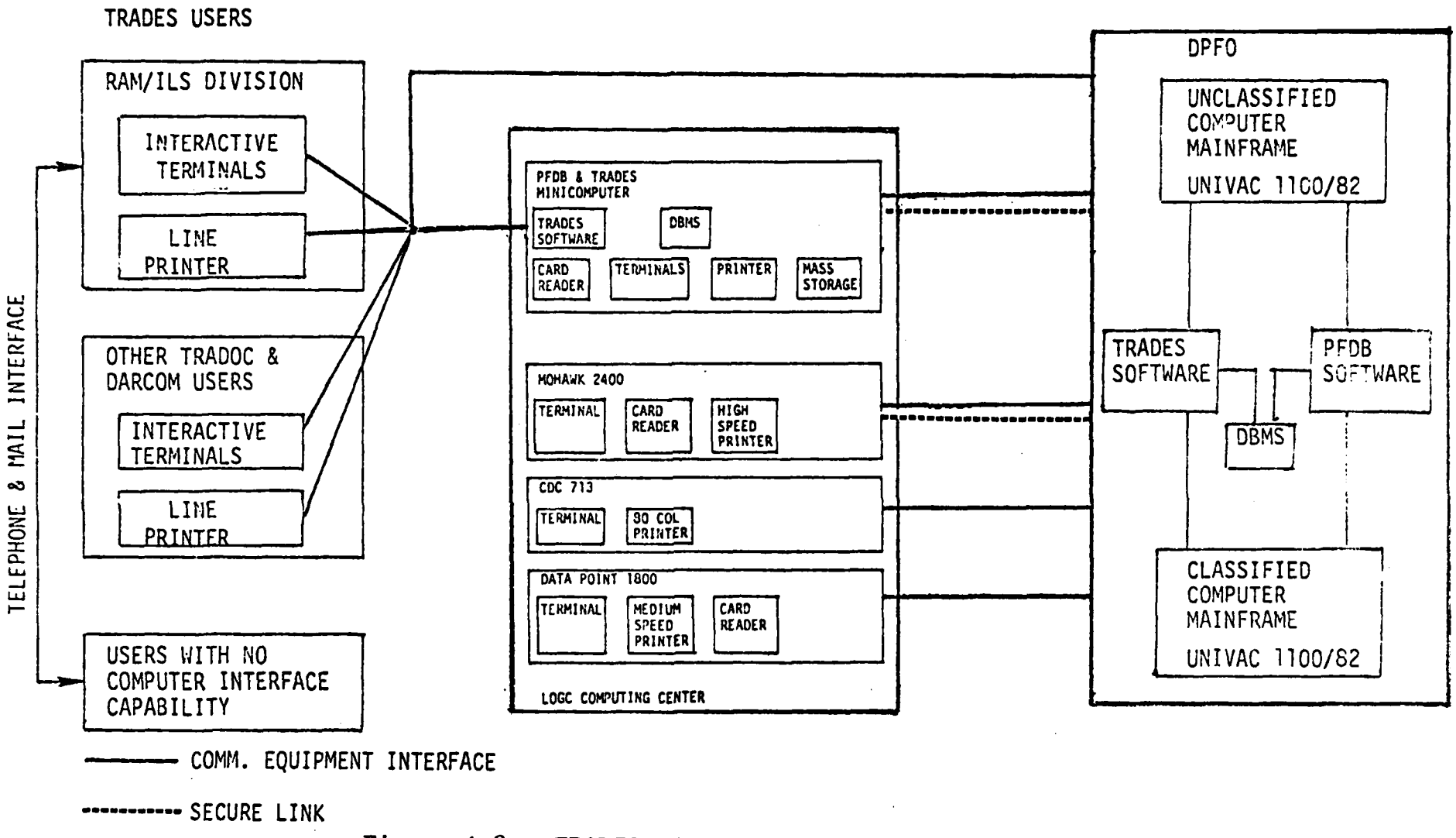

Figure 4-3. TRADES Alternative Concept of Operation (ACO) Using PFDB System

However, the software for TRADES and PFDB will be designed for stand-alone operation.

3. Interoperability capabilities between TRADES and PFDB would be facilitated.
4. Interface development with users common to both PFDB and TRADES would be accomplished once instead of twice.
5. A single facility for both TRADES and PFDB would simplify procedures for users and inputs from various sources (some common).

Several assumptions were made in order for the ACO to meet all of the TRADES requirements. These are described below:

1. The TRADOC DPFO will accommodate a dedicated line from the TRADES PFDB mini-computer for both secure and unclassified processing.
2. The TRADOC DPFO will accommodate interactive demands (less than 160 per day), and batch jobs with turnaround in less than 2 weeks from a service standpoint.
3. TRADES and PFDB software will be developed using the same language.
4. Future development of TRADES and PFDB will be managed jointly between the Materiel Systems Directorate and Operations Analysis Directorate at the LOGC.
5. A secure area and appropriate facilities will be provided for TRADES and PFDB classified terminals and data storage.

ORGANIZATIONAL CHARACTERISTICS

Contained in this section will be a general description of the organizations required to operate and maintain this TRADES-PFDB Alternative Concept of Operation (ACO) at the LOGC.

LOGC TRADES Organization: RAM/ILS Division

To effectively operate and maintain the computer aspects of this TRADES-PFDB ACO with respect to the stated requirements in the SRD. The six additional functional personnel discussed in Chapter II will be required in the TRADES office within the RAM/ILS Division of the Materiel Systems Directorate and one (1) additional Computer Specialist/Data Base Administrator to the Planning Factors Management Division*.

* This does not consider the personnel and funding resources required in the TRADOC integrating centers, test boards, schools or other TRADOC supporting elements.

The functions of the TRADES office will be to support the TRADES-MTD in:

1. TRADES management
2. Customer service
3. TRADES development and enhancement
4. RAM analysis

The additional TRADES Specialist assigned to PFMD will:

1. Coordinate developments and enhancements to TRADES and PFDB.
2. Coordinate TRADES customer service requirements between the TRADES office, PFMD, DPFO, and the LOGC Computing Center.
3. Monitor and manage jobs submitted to LOGC Computing Center (PFDB-TRADES mini-computer) and DPFO.
4. Participate in TRADES enhancement and development studies.

External Organizational Interfaces

Schools and centers will be primary functional customers/users of the TRADES system, and also serve a role as proponent for entries affecting systems for which they are responsible. In some cases, workload may justify the assignment of additional RAM personnel. Interface between these organizations and the LOGC is absolutely vital, to ensure that requirements (job runs, interactive service, protocol, storage requirements) are met, and files reviewed and updated on a timely basis.

Other organizational interfaces may include data sources (DARCOM activities, TRADOC boards and other test activities), as well as other users of TRADES, such as HQ, DA Logistics Evaluation Agency (upon occasion). These external interfaces must be coordinated by the TRADES Management Branch and performed by the computer systems of the respective agencies wherever possible.

The functions of the TRADES personnel in the RAM offices of the TRADOC schools will be to support TRADES in:

1. Update of the Quick Response Module data.
2. Customer Service
3. RAM Analysis.

PROCEDURAL CHARACTERISTICS

The users of this TRADES-PFDB Alternative can be categorized as those with unclassified computer interface capability (e.g., have interactive terminals with acoustic coupler), those with secure access, and those with no terminals available.

Those users with computer terminal and acoustic coupler equipment can access TRADES directly on the PFDB-TRADES mini-computer located in the LOGC Computing Center or UNIVAC 1100/82 time sharing mainframe at DPFO, Fort Leavenworth via normal telephone lines (Telephone numbers will be assigned by DPFO and the LOGC Computing Center to appropriate computer access ports).

Normal "log in" procedures to access the mini-computer or the mainframe will be used to interact with TRADES.

For users who have computer terminals and secure link capability, access is gained with procedures similar to those described above for unclassified users.

Lastly, for those users who do not have terminals (estimated to be about 50% in SRD), solicitation for RAM data and analysis products will be made by mail or telephone calls to the TRADES office. The additional staff recommended previously will be sufficient to handle the initial load (growth in number of users in the future may necessitate additional personnel).

An additional function to be performed by the TRADES office will be the development of new data and provision of customer service. Analysts will assist in the validation of new or updated RAM data on a continuous and controlled basis before entry into the TRADES and provide customers (with or without terminals) with periodic reports of changes or modifications to TRADES in terms of data, hardware, software, management, procedures, and regulations.

Procedural control of classified data must be accomplished in accordance with appropriate regulations and restrictions.

It is recommended that a TRADES Army Regulation document and TRADES Users/Programmers Guide be developed for management of the program.

ADPE CONFIGURATION

Hardware

The Automatic Data Processing Equipment (ADPE) and hardware used in this TRADES concept configuration consist of the following:

1. Two time sharing computer mainframes with large mass storage. Data Base Management System (DBMS), communications ports, etc., one for unclassified and the other for classified data processing.

2. A micro-computer with disk storage or interactive terminals, with communications capability (several terminals may be multiplexed off a single telecommunications link to a host computer).
3. Classified and unclassified communications interface equipment between users, mini-computer and mainframe.
4. A mini-computer with interactive capability having its own DBMS batch terminal, public and private disk packs, a nine-track tape drive, and communications equipment, so that it can operate independently.
5. Dedicated link between the PFDB-TRADES mini-computer and UNIVAC 1100/82 machines.

Communication requirements include the communications between the two sites and between external users and PFDB. Communications between the two sites (LOGC and DPFO) will be by direct communication link and by magnetic tape, magnetic disk and punched cards. It is estimated that 2 to 5 telephone extensions will be needed for interactive computer transmission. Several I/O devices will be required at PFMD.

Figure 4-4 shows an overview of the hardware required in this configuration.

Software

The software to be developed for this TRADES concept will consist of the following five software modules:

1. Management Module
2. Source Identification Module
3. Quick Response Module
4. Statistics/Analysis Module
5. Interface Module

HARDWARE	CONCEPT CHARACTERISTICS
Mainframe	Time share with DPFO large mainframe computer with batch and interactive capability through terminals.
Mini-computer	Utilizes a mini-computer with multiple terminals capability to handle processing and report dissemination. Estimated need of 2-4 MB of local memory.
Line Printer	Use high speed line(600 LPM)printer located at LOGC Computing Center.
Card Reader	Use 50-200 CPM Card Reader located at LOGC Computing Center.
Tape Drives	Use 9-Track tape drives located at LOGC Computing Center.
Disk Drives	Use DPFOs and LOGC disk drives and disks for support of TRADES. Minimum of 90 MB storage capability.
Micro-Computers or Interactive Terminals	Use micro-computers or any interactive terminal with communications equipment for interactive operations.
Security Equipment	Use KG device for I/O transactions.
Communications Equipment	Use a 4800 Baud dedicated line from the TRADES office via the PFDB-TRADE mini-computer office to DPFO and other computer ports for interactive processing.
Multiplexers	A synchronous, minimum of light communications lines.
Modems	Modems and cables as necessary for multiplexer requirement. Also needed with each terminal/mini-computer
Graphics Terminals	Graphics terminals, preferably color system, for requirements and performance charting.

Figure 4-4. Hardware Overview

These modules and overall software systems design are described in detail in the methodology section of this report. These modules will control data input, output, retrieval, update, manipulation, and changes. For this alternative, the TRADES software will be developed in conjunction with and in the same language as that specified for PFDB. However, TRADES will be developed as a stand-alone system, i.e., the software systems will be separate.

This concept requires a DBMS to be resident on the mainframe as well as on the mini-computer.

CHAPTER V

MAINTENANCE TASK DEMAND (MTD) FILE ALTERNATIVE

GENERAL

The objectives of the design of the TRADES alternative incorporating the Maintenance Task Demand (MTD) File System (TRADES-MTD Alternative) are to:

1. Meet the requirements for TRADES as delineated in the System Requirement Descriptions (SRD).
2. Utilize to the extent possible a system which has already been designed, developed, tested and implemented.
3. Avoid long development lead times and excessive costs for TRADES.

The MTD File System is operational and is managed by the Technical Design and Validation Branch of the Planning Factors Management Division (PFMD) at the LOGC. This system (described in Chapter V of the SRD) currently runs on the UNIVAC 1100/821 at the TRADOC Data Processing Field Office (DPFO) located at Fort Leavenworth, Kansas. It has both user interactive and batch processing capability. The System 2000 Data Base Management System (DBMS) for data storage, manipulation, and retrieval is also available on the system. A simplified diagram of the MTD File System organization is shown in Figure 5-1

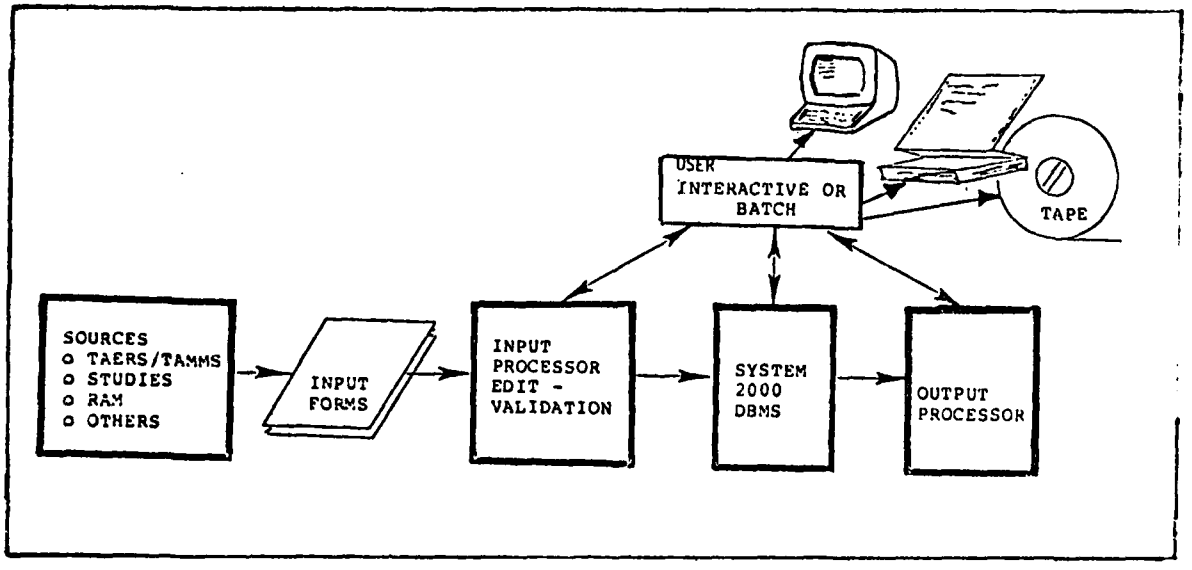

Figure 5-1. MTD File System Organization

The MTD File System is a stand-alone system managed by the Planning Factors Management Division (PFMD), which will eventually be integrated into PFDB in both hardware and software.

Figure 5-2 shows the TRADES configurations using the MTD File System. The most significant consideration in this configuration is the development of the TRADES software which will incorporate the MTD File System. The main software pre-processor and post-processor will need to be modified to fit the TRADES requirements in terms of the management, source identification, quick response, statistical/analytical, and interface modules described in the methodology portion of this report.

Several assumptions were made in order for the alternative to meet all of the TRADES requirements. These are described as follows:

1. The TRADOC DPFO's computer system will accommodate 160 requests per day interactively or batch with job turnaround in less than 2 weeks from a service standpoint.
2. TRADES software will be written in FORTRAN IV.
3. Mass storage capability at DPFO is sufficient for the TRADES-MTD alternative using the System 2000 DBMS.
4. Future development and growth of this alternative will be addressed as part of the PFDB development.
5. A secure area and appropriate facilities will be provided by the LOGC for TRADES classified terminal and data storage.

ORGANIZATIONAL CHARACTERISTICS

Contained in this section will be a general description of the organizations required to operate and maintain this TRADES-MTD alternative at the LOGC.

Internal TRADES Organization: RAM Directorate

To effectively operate and maintain the computer aspect of the TRADES-MTD alternative, it is estimated that the six additional functional personnel discussed in Chapter II will be required in a TRADES office within the RAM/ILS Division.

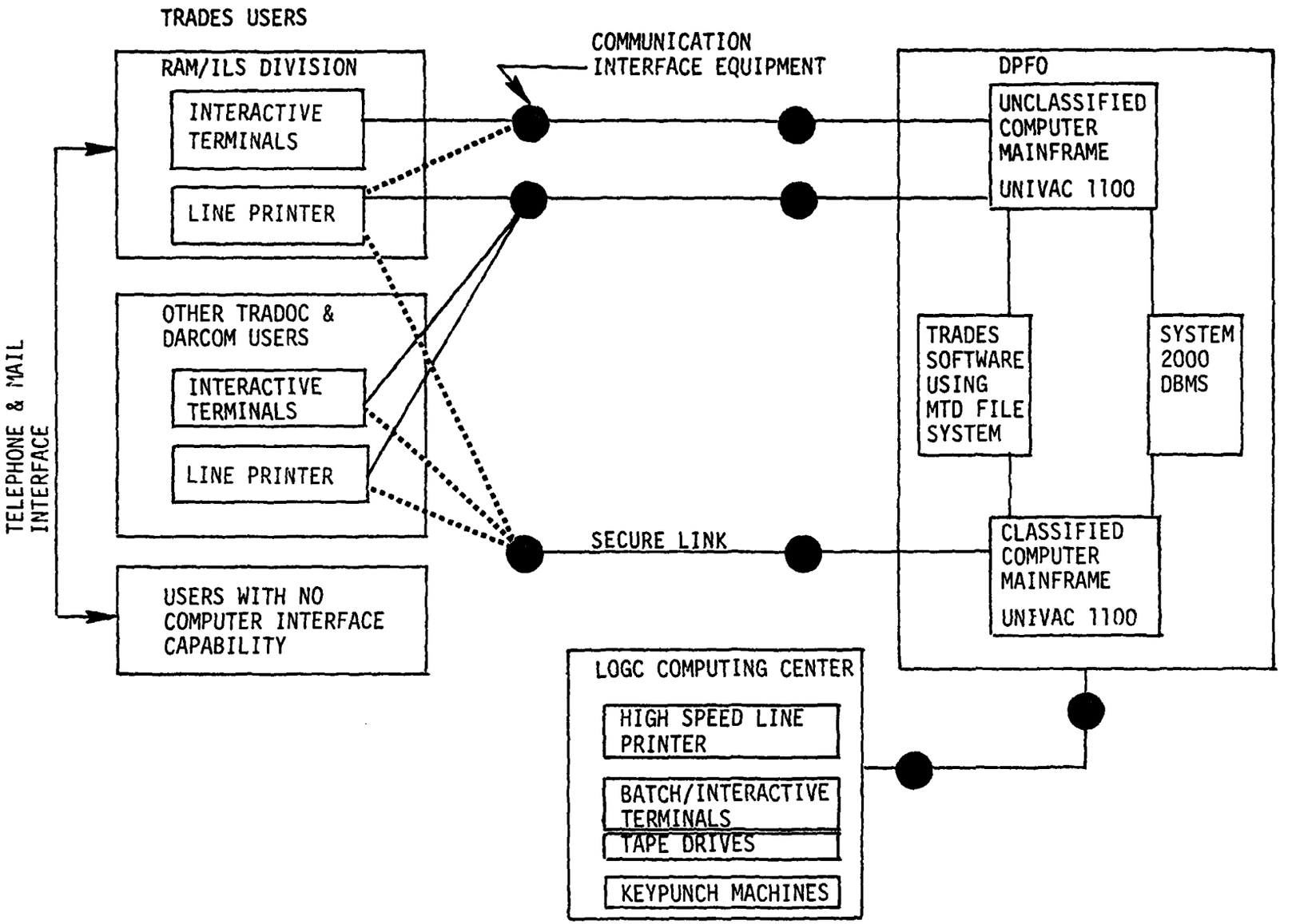

Figure 5-2. TRADES Configuration Using The MTD File System

The functions of the TRADES office will be to support the TRADES-MTD in:

1. TRADES Management
2. Customer Service
3. TRADES Development and Enhancement
4. RAM Analysis.

External Organizational Interfaces

Interface between the TRADES office and the Planning Factors Management Division (PFMD) is essential for coordinated development of both the MTD File System and TRADES, i.e. any software or hardware developments may be mutually beneficial for capabilities enhancement. Further, interface between the TRADES office and DPFO is required to ensure adequate service and UNIVAC support is maintained, and TRADES requirements (job runs, interactive service, protocol, storage requirements, etc.) are coordinated.

The other organizational interfaces will include the organizations (other LOGC Directores, TRADOC Schools and Centers, TRADOC Boards, and DARCOM activities) that interact with the TRADES either as users or sources.

PROCEDURAL CHARACTERISTICS

The users of this TRADES-MTD alternative can be categorized as those with unclassified computer interface capability (e.g. have interactive terminals with acoustic coupler), those with secure access computer interface capability, and those without any terminals.

Those with computer terminal and acoustic coupler capability can access TRADES on the mainframe, UNIVAC 1100/82, via normal telephone lines (telephone numbers will be assigned by DPFO to appropriate computer access ports). Normal "log in" procedures will then be used to interact with TRADES.

For users who have computer terminals and secure link capability, access is gained with procedures similar to those described above for unclassified data users.

Lastly, for those users who do not have terminals (estimated to be about 50% in SRD) solicitation for RAM data and analysis products will be made by mail or telephone calls to the TRADES office. The additional staff recommended previously will be sufficient to handle the initial load (growth in number of users in the future may necessitate additional personnel).

An additional function to be performed by the TRADES office will be the development of new data and provision of customer service. Analysts will assist in the validation of new or updated RAM data on a continuous and controlled basis before entry into the TRADES and provide customers (with or without terminals) with periodic reports of changes or modifications to TRADES in terms of data, hardware, software, management, procedures, and regulations.

Procedural control of classified data must be accomplished in accordance with appropriate regulations and restrictions.

It is recommended that a TRADES Army Regulation document and TRADES Users/Programmers Guide be developed for management of the program.

ADPE CONFIGURATION

Hardware

The Automatic Data Processing Equipment (ADPE) and hardware used in this TRADES concept configuration consist of the following:

1. Two computer mainframes with large mass storage, FORTRAN compiler, System 2000 DBMS, communications ports, etc., one for unclassified and the other for classified data processing.
2. A micro-computer with disk storage or interactive terminals with communications capability (several terminals may be multiplexed off a single telecommunications link to a host computer).
3. Classified and unclassified communications interface equipment.

Figure 5-3 shows an overview of the hardware required in this configuration.

HARDWARE	CONCEPT CHARACTERISTICS
Mainframe	Time share with large mainframe computer with batch or interactive capability through terminals.
Line Printer	Use high speed line 600 LPM printer located at LOGC Computing Center.
Card Reader	Use 50-200 CPM Cord Reader located at LOGC Computing Center.
Tape Drives	Use 9-Track tape drives located at LOGC Computing Center.
Disk Drives	Use DPFOs disk drives and disks for support of TRADES.
Micro-Computers or Interactive Terminals	Use micro-computers or any interactive terminal with communications equipment for interactive operations.
Security Equipment	Use KG device for I/O transactions.
Communications Equipment	Use a 4800 Baud dedicated line from the TRADES office to DPFO and other computer ports for interactive processing.

Figure 5-3. Hardware Overview

Software

The software to be developed for this TRADES concept will consist of the following five software modules:

1. Management Module
2. Source Identification Module
3. Quick Response Module
4. Statistical/Analytical Module
5. Interface Module

These are described in detail in the methodology section of this report. These modules will control data input, output, retrieval, update and changes. For this alternative, the TRADES software will be written in FORTRAN and incorporate, to the extent feasible, the software already developed for the MTD File System. It is estimated that the MTD File System software will comprise 40%-60% of the TRADES software. Also, the concept will utilize the System 2000 DBMS and its data base language for ad hoc queries into the TRADES data base.

CHAPTER VI

LOGC ADPE REQUIREMENTS STUDY ACO ALTERNATIVE

GENERAL

This alternative concept is the same as the Planning Factors Data Base (PFDB) Alternative, except that a second mini-computer has been added to the configuration.

The recommended ACO resulting from the LOGC Automatic Data Processing Study is shown in Figure 6-1. This alternative employing three mini-computers was designed to support the logistics exercise (LOGEX), PFDB, and other LOGC workload by using the flexibility of three interconnected mini-computers. These computers can accommodate varying requirements for LOGEX, PFDB, TRADES, and other special systems. This combination provides enhanced responsivenss and reliability in supporting Logistics Center data processing. Phase I of the LOGC ADPE Requirements Study has been completed and approved. Phase II, to occur in the near future, will result in Detailed Functional System Requirements (DFSR) to begin the formal AR 18-1 development cycle.

Figure 6-2 shows the TRADES using the LOGC ADPE Requirements Study Concept. This TRADES ACO takes advantage of the LOGEX mini-computer shown in Figure 6-1.

The LOGEX mini-computer to be used principally for batch processing, will be located in a secure environment so that it may be connected to either the secure or unsecure machines. When the central machine is connected to the unsecure mini-computer, users can submit unclassified jobs through the local batch terminal or through the unsecure communications mini-computer. When this mini-computer is connected to the secure PFDB-TRADES mini-computer, classified processing can occur in a similar manner. During normal operation, the central machine will process unclassified work and classified batch jobs will be routed to remote sites (e.g., DPFO) or queued for later processing locally.

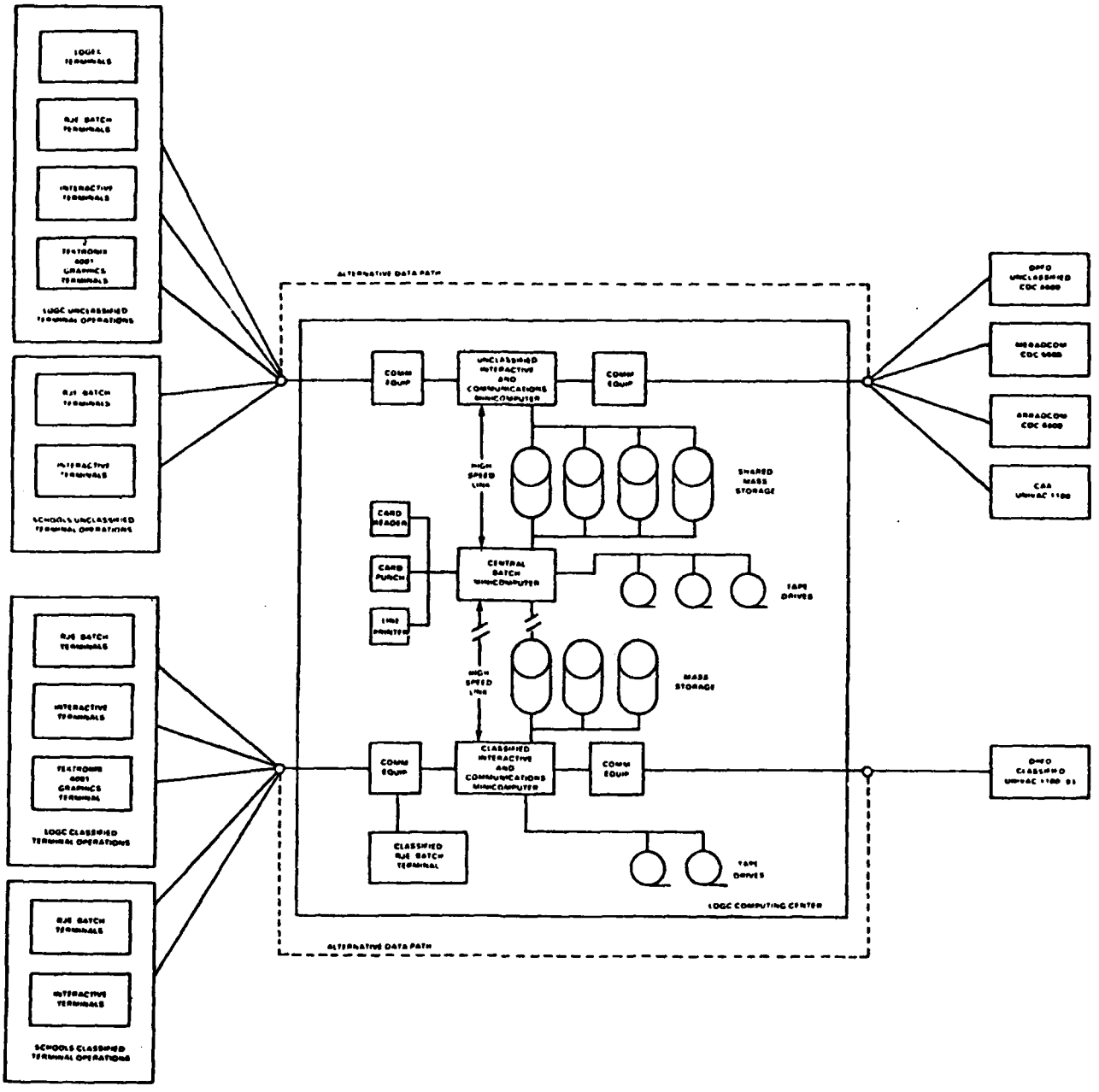

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Figure 6-1. LOGC ADPE Concept

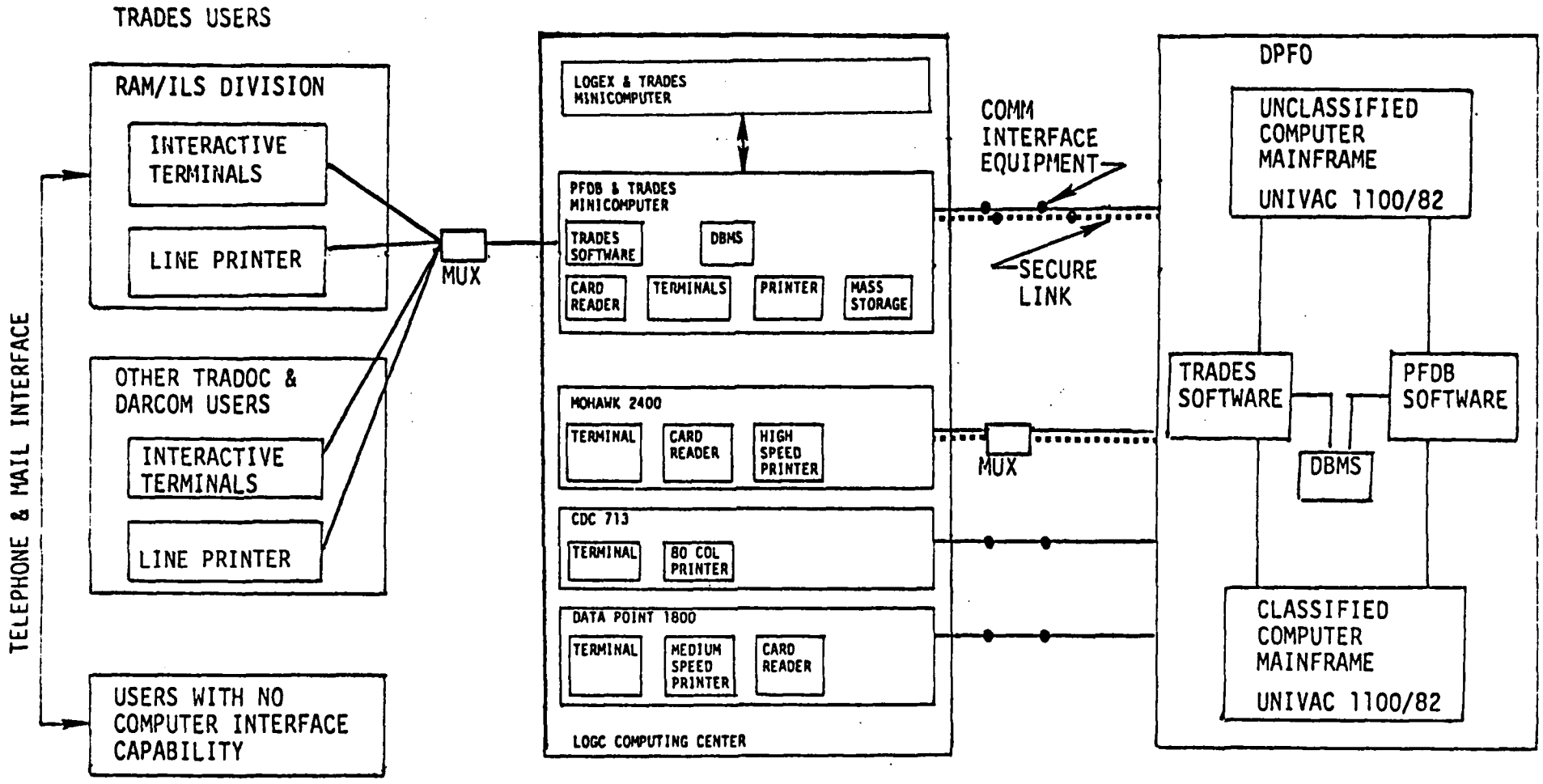

Figure 6-2. TRADES ACO Using the LOGC ADPE Concept

Users of the mini-computer from remote sites will utilize remote batch terminals or interactive terminals to connect with the Fort Lee, Va. facility. The communications equipment at the facility will route or queue jobs for the appropriate computer site. As an emergency backup feature, remote users can tie in directly to the mainframe computers as necessary.

During the support of LOGEX, the LOGEX and TRADES shared mini-computer will be dedicated solely to LOGEX. Two batch terminals and two interactive terminals will be moved to the area of the logistics exercises and tie in directly to the central computer by telephone lines.

With this ACO, TRADES will be supported by two mini-computers locally at the LOGC giving more flexibility and capability in terms of growth, customer service and responsiveness.

The Organizational Characteristics, Procedural Characteristics and ADPE Configuration will be the same as that described for the Planning Factor Data Base (PFDB) Alternative, with the exception of the LOGEX mini-computer being added for TRADES utilization.

CHAPTER VII

STAND-ALONE TRADES

GENERAL

In this ACO, TRADES is considered from the viewpoint of a stand-alone or free-standing system, i.e., independent of other existing or planned computerized systems.

The essential computer characteristic required to satisfy the TRADES concept is random access with a substantial data storage capability. From a management standpoint, it is clearly desirable to minimize both initial procurement and annual maintenance/ operating costs.

When considered independently of the type of computer, the stand-alone TRADES concept could be designed for a large, modern main frame computer. However, current computer technology and state-of-the-art makes several mini-computers available which might satisfy the TRADES requirements. Thus, it is also conceivable to consider a mini- or micro-computer as a "stand-alone" system for accessing, updating, and maintenance of TRADES. The major difference between a mini-computer and a large main frame, such as the TRADOC DPFO at Ft. Leavenworth, would be in access and processing times.

The large computer facility at the DPFO has a much faster internal processing time than the mini-computers. However, since the computer facility is used primarily for information search, internal operating speed of mini-computers is not considered a significant factor for TRADES.

The main attractions of the mini-computer are modest initial investment and annual maintenance and operating costs, together with direct accessibility by TRADES management personnel and relative simplicity of operation.

CENTRALIZED VS DISPERSED CONFIGURATION

The advent of the economical micro-computer provides an opportunity to consider dispersed rather than a centralized TRADES configuration.

In the centralized configuration, the computer (either a main frame or an adequate mini-computer) would be assigned to a central activity with access via interactive terminals at each potential user. All programming, software development, file update, etc., would be accomplished at a centralized agency.

In a dispersed configuration, each potential user (or selected activities) would be provided with a business micro-computer facility. To facilitate standardization and consistency of files, all software and file development would still be accomplished at a centralized activity, but distributed to the various computer sites for application.

The centralized configuration has the benefit of local control of all software and files in TRADES. Likewise, total cost is minimized in that only one system is required with adequate capacity to satisfy all user requirements. Users would be equipped with relatively inexpensive terminals with the capability of interacting not only with the TRADES central computer, but also with all ADP computer centers. The principal disadvantage might be inaccessibility to the TRADES computer in heavy workload hours.

Personnel and funding required in the TRADOC integrating centers, test boards, schools, or other TRADOC supporting elements were not considered. This is because in each case, it is envisioned that functional personnel would be located in the TRADOC integrating centers and schools, test boards, and in a coordinating branch in the RAM/ILS division of the Materiel Systems Directorate.

The SRD report estimates that an average of 19,500 requests would be made per year against a mature TRADES by the total TRADOC community. This would average 75 requests per working day, or one request every six minutes (on an eight-hour work day). Based on experience with such data centers, most

requests are placed within the first three to four hours of each work day. This would most likely overload the capability of a single mini-computer unless it had several access ports with multiplexing capabilities.

A principal advantage of the centralized configuration would be in cost. Assuming that a microcomputer (complete with peripherals) could be purchased (in quantity) for $6,000 - even a minimum of 40 such computer facilities would incur an expense of $240,000, which starts to approach the purchase cost of a high-capacity modern technology computer. On the other hand, the large main frame at the TRADOC DPFO, is a sunk cost, available at no cost to TRADES.

Additionally, many schools that presently have a one-man RAM office would require a computer specialist/maintenance/programmer to support the microcomputer at an annual direct operating cost of approximately $1.5M-2.0M. This computer specialist would be used to input information into TRADES files relative to the assigned school/center. However, this can be accomplished more efficiently from a centralized TRADES office. The main advantage of the dispersed concept would be that each TRADOC user would have a direct access to a computer to assist him in his efforts. Recognition must be provided to the accommodation by TRADES of microcomputer at the user level.

For purposes of ACO evaluation, the centralized configuration shown in Figure 7-1 will be the basis for analysis.

ORGANIZATIONAL CHARACTERISTICS

A general description of the organizations required to operate and maintain the stand-alone TRADES alternative is presented in this section.

Internal TRADES Organization:
LOGCEN

To effectively operate and maintain the stand-alone TRADES alternative, it is estimated that the additional six functional personnel discussed in Chapter II would be required in the RAM/ILS Division.

Functions of the TRADES office will be:

1. TRADES management
2. Customer service
3. TRADES development and enhancement
4. RAM analysis.

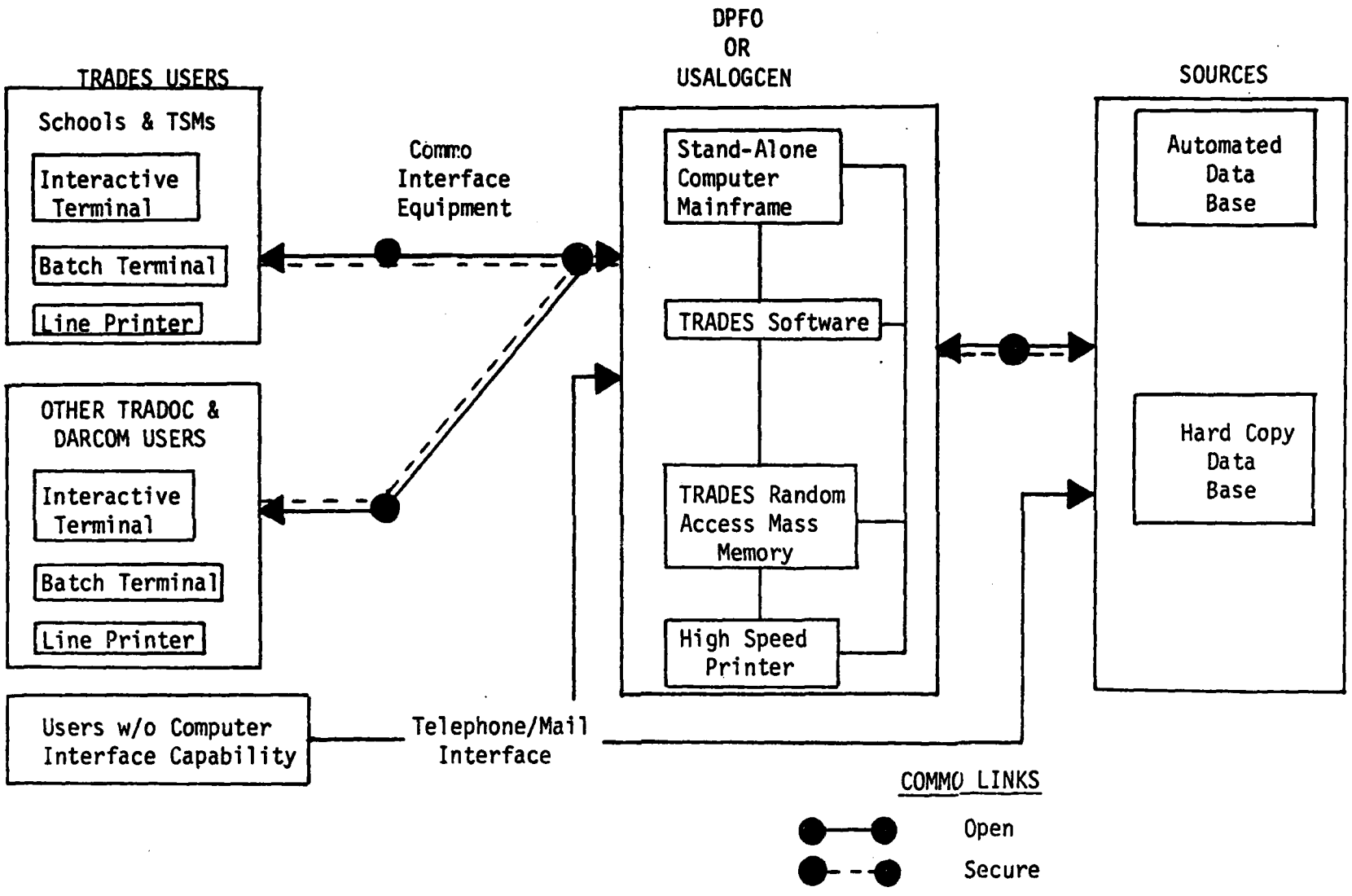

Figure 7-1. TRADES Configuration Using Centralized Stand-Alone Computer Facility

External Organizational Interfaces

The major external organizational interfaces in this ACO are the ADP computer facilities identified as RAM data sources within TRADES. There will be a high level of communication required between TRADES and the facility which houses the source data. Communications will be required for either data transfer (where the source computer facility cannot provide the required analysis), or for coordination of data analyses, and output, where the user can take advantage of software at the computer facility for direct output.

The source identification module provides the key to external operational interfaces required. Provision is made within the TRADES interface module as to specific interface requirements for each source identified that has automated RAM data base available. These references also indicate whether source computer software (associated with the specific RAM data identified) can provide analysis in an output format satisfactory to the user, or whether a requirement exists to use the statistical/analytical module to process data required.

In the latter case, external operational characteristics could be directed to two procedures:

1. The computer at the RAM data source can accept a software package for analysis of data and provide a predesignated output format
2. Data must be extracted from the resident data bank, stored temporarily on a TRADES computer, and analyzed with the statistical/analytical module programs.

PROCEDURAL CHARACTERISTICS

Users of stand-alone TRADES alternatives may be categorized as having unclassified computer interface capability (e.g., interactive terminals with acoustic coupler), secure access computer interface capability, and those without any terminals.

Users with computer terminal and acoustic coupler capability can access TRADES via normal telephone lines (numbers will be assigned by LOGCEN). Normal "log in" procedures will then interact with TRADES.

Users with computer terminals and secure link capability, gain access with procedures similar to those for unclassified data users.

Lastly, for users with no terminals (estimated to be about 50% in SRD), solicitation for RAM data and analysis products will be by mail or telephone calls to the TRADES office. The staff recommended above will be sufficient to handle the initial load (growth in future users may necessitate additional personnel).

An additional TRADES office function will be development of new data and provision of customer service. Analysts will assist in validation of new or updated RAM data on a continuous and controlled basis before entry into TRADES, and provide customers (with or without terminals) with periodic reports of changes or modifications to TRADES, in terms of data, hardware, software, management, procedures, and regulations.

Procedural control of classified data must be accomplished in accordance with appropriate regulations and restrictions.

It is recommended that a TRADES regulatory document and TRADES Users/Programmers Guide be developed for program management.

ADPE CONFIGURATION

The ADP hardware utilized in this ACO, as shown in Table 7-1, could be either a mini-computer or a large main frame computer center. The system should be equipped with high-speed line printers and CRTs.

Interactive terminals will be available (or will be made available) to all potential RAM users within the TRADOC community. These terminals will be capable of interactive communication with the TRADES computer.

TABLE 7-1. HARDWARE OVERVIEW

HARDWARE	CONCEPT CONSIDERATIONS	
	MINI-COMPUTER	LARGE MAIN FRAME
Main Frame	Modern tech. mini-computer w/random access, large core CPU & multiple process. feature	Time-share w/any large main frame computer center w/batch or interactive capability through terminals
Line Printer	Use high speed line printers at LOGC and at potential TRADOC user facilities	
Disk Drives	Use high density hard disk drives w/ 20-30 megabyte capacities or better	Use disk drives and disks available at data processing center
Interactive Terminals	Use interactive terminals with compatible commo equipment. Provide interactive terminals to other TRADOC users	
Security Equipment	Provide KG devices for all I/O transactions	
Communications	Use dedicated line from RAM/ILS TRADES Branch to TRADES Computer Center	

The TRADES software will consist of the five basic modules described in Chapter II, plus a master executive program. In this ACO, the TRADES software will be developed as an independent system design, using the language and logic best suited to the computer selected as the main frame.

CHAPTER VIII

ANALYSIS OF ALTERNATIVES

GOAL

This chapter compares the ACOs described in Chapters IV, V, VI and VII above, using the evaluation criteria established in Chapter III. The four alternatives are measured against requirements established in the methodology (Chapter II). The evaluations include a discussion of advantages and disadvantages of the alternatives as they relate to individual EEAs.

ACO COMPARISON SUMMARY

The SRD developed specific requirements for TRADES utility to the TRADOC community (major issues raised by these requirements were discussed in Chapter II). Table 8-1 presents a comparison of the four ACOs against each EEA. These will be reviewed in consideration of the differences among the concepts portrayed in the preceding chapters.

Table 8-2 addresses the hardware requirements among the ACOs. The only differences in hardware among the ACOs is the alternative use of the OAD mini-computer(s) and the DPFO main frames. The MTD and SAMF ACOs have no OAD mini-computer but use the DPFO main frame as the primary computer. The other alternatives use the DPFO main frame as a backup and share of at least one OAD mini-computer. The ADPE concept uses two OAD computers on a shared basis, either of the two available, depending on their individual workloads.

The terminals identified for the RAM/ILS Division and the users could be of any type, as long as they are interactive and compatible with the overall system design. It is considered that they might be micro-computers which provide TRADOC users with computational facilities to assist their tasks as RAM engineers.

TABLE 8-1. ACO RELATIVE COMPARISONS

ESSENTIAL ELEMENTS OF ANALYSIS	PFDB	MTD	ADPE	SAMI	SAMF
RESPONSIVENESS					
Turnaround Time/Query	*	*	*	*	*
Query Processing:					
-Hard Copy Response	*	*	*	*	*
-Auto. Data Avail. Response	*	*	*	*	*
Interface Module Proc. of Automatic Data Source:					
-Report from Source	*	*	*	*	*
-Data from Source	**	May be ltd. by Space Alloc.	**	**	May be ltd. by Space Alloc.
-Data Processing on TRADES	Relatively Slow	Relatively Fast	Relatively Slow	Relatively Slow	Relatively Fast
-Output Formating	*	*	*	*	*
Stat./Anal. Module Processing:					
-Data from Automated Source	*	*	*	*	*
-Data Entry by User	**	May be ltd. by Port Access	**	**	May be ltd. by Port Access
-Output Formating	*	*	*	*	*
Quick Response Module Query	*	*	*	*	*
Management Module Processing:					
-Management Data Analysis	*	*	*	*	*
-Corporate Memory Stor./Process.	Limited by Capacity	May be ltd. by Space Alloc.	Limited by Capacity	Limited by Capacity	May be ltd. by Space Alloc.
Level of RAM Data Structure	*	*	*	*	*
RAM Data Form	*	*	*	*	*
Stat./Anal. Manipulations	*	*	*	*	*
Quick Resp. "Standard" EEI Values	*	*	*	*	*

*Meets TRADES requirement and equal capabilities have been provided.
**Meets Requirement

TABLE 8-1. ACO RELATIVE COMPARISONS (Concluded)

ESSENTIAL ELEMENTS OF ANALYSIS	PFDB	MTD	ADPE	SAMI	SAMF
QUALITY CONTROL					
Edit	*	*	*	*	*
Validation	*	*	*	*	*
SECURITY					
Software	*	*	*	*	*
Data Base	*	*	*	*	*
Classification	*	*	*	*	*
IMPLEMENTATION TIME (RELATIVE)	1.0	0.9	1.0	1.0	1.0
RESOURCE REQUIREMENTS					
$Cost:					
-Equipment	*	*	*	*	*
-Manning	7 Add'l. Personnel	6 Add'l. Personnel	7 Add'l. Personnel	6 Add'l. Personnel	6 Add'l. Personnel
ACCESSIBILITY TO PROPONENTS					
Terminals	*	*	*	*	*
Telecon	*	*	*	*	*
EEIs	*	*	*	*	*
FLEXIBILITY					
Interactive	*	*	*	*	*
Batch Processing	*	*	*	*	*
INTEGRATION w/OTHER SYSTEMS (RAM data Sources w/ADP Systems)	*	*	*	*	*
BACKUP CAPABILITY	Uses DPFO as Backup	No Backup	Uses DPFO as Backup	Uses DPFO as Backup	No Backup
GROWTH POTENTIAL	L'td. to DPFO Capacity	L'td. to DPFO Capacity	L'td. to DPFO Capacity	L'td. to OAD Mini-Computer Capacity	L'td. to DPFO Capacity

*Meets TRADES requirement and equal capabilities have been provided.

TABLE 8-2. ACO COMPARISON - HARDWARE REQUIREMENTS

ACO	RAM/ILS DIV.	AOD	DPFO	USERS
PFDB	1-Terminal 1-Line Printer 1-Multiplexer	1-Mini-computer 1-Terminal 1-Multiplexer 1-Line Printer 1-Tape Drive 1-Disk Drive 1-Key Punch	1-Main Frame (backup)	1-Terminal 1-Multiplexer 1-Line Printer
MTD	(Same as PFDB)	(Same as PFDB less Mini) 1-Terminal & Multiplexer	1-Main Frame	(Same as PFDB)
ADPE	(Same as PFDB)	(Same as PBDB + 2nd Mini)	(Same as PFDB)	(Same as PFDB)
SAMI	(Same as PFDB)	(Same as PFDB)	(Same as PFDB)	(Same as PFDB)
SAMF	(Same as PFDB)	(Same as PFDB, less Mini) 1-Terminal & Multiplexer	1-Main Frame	(Same as PFDB)

EVALUATION

Responsiveness

In almost all areas, there are no significant differences among the ACOs. For example, actual processing time on large-scale computers of the UNIVAC 1100 series would be somewhat faster than a mini-computer. However, because of the low computation nature of most queries, the time differential would become insignificant. The greatest variance would be in the type of data base management system used. If the same system was used, there would be no differences. If one system incorporates a more efficient data base management system for this program, it would have a slight advantage.

The only significant differences among the ACOs result from the general characteristics of mini-computers, and the fact that the UNIVAC 1100 used for the MTD and SAMF ACOs is not "dedicated". On this basis, these differences may become significant:

1. It has been reported that in the past the MTD experienced long queues (up to two days) for access to the DPFO. This condition is stated to have been resolved. SAMF & MTD ACOs could experience the same queues. On the other hand, the PFDB, ADPE and SAMI mini-computers are backed up by the DPFO only during high peak workload.

2. The multiple users of the UNIVAC 1100 in the TRADOC DPFO can significantly limit the total space available to TRADES for extracting large data bases from automatic data sources for internal processing as well as for the storage of corporate memory data in the management module. Furthermore, accessibility of the DPFO (discussed above) may limit the usefulness of these ACOs for data entry by the RAM users for independent statistical/analysis module processing. These potential limitations may be overcome by expansion of the DPFO.

   As to the stand-alone mini-computer, the extent to which data may be extracted from sources, or the available corporate memory storage, will be limited by the capacity of the system selected and the space allocated within its mass memory for such activities.

Accessibility to Proponents

Table 8-1 notes that the five alternatives have equal characteristics with regard to accessibility. However, the concept of TRADES should be that the automatic data system be ultimately directly available to all TRADOC proponents. Accordingly, access by voice communication should eventually be replaced by the availability of terminals to all RAM users.

Flexibility

A basic concept of TRADES is for each ACO to include interactive capability. However, on occasion, batch processing may be desirable. The DPFO and OAD mini-computers currently have this capability. However, depending on the degree of desirability of batch processing, this feature may not be feasible for certain low-cost micro-computers that may be provided each user as a terminal. If batch processing is a definite requirement at the user, the available choice of micro-computers as terminals is more restricted.

The overall TRADES SRD established operational flexibility requirements. Addressed elsewhere, they concern growth potential, EEI expansion, number of users, integration with other systems, etc. With these requirements, all ACOs provide a flexible system.

Integration with Other Systems

This requirement addresses the ability of TRADES hardware/software to communicate with RAM data sources which have ADP systems. The only presently operating system, MTD, has full capability of communicating with all other large-scale computer systems in the DA. Such capability is now widely available for current generation systems, limited in some cases as to data rate, and will be accommodated likewise in all alternatives.

Growth Potential

Since the MTD and SAMF consider that TRADES will be resident on the TRADOC DPFO, growth potential for TRADES is thus limited to the capacity and utilization rates allocated by the computer center for TRADES. This does not obviate procurement of additional computer facilities at the DPFO to satisfy increasing capacity requirements. However, such expansion programs are beyond the scope of this analysis.

With regard to the mini-computer ACOs, it is considered that there is no near-term limit to the growth potential of TRADES as long as the mini-computer is not assigned competing tasks of higher priority. It is unlikely that the required software and storage capacity will exceed the limitation of the general category of hardware designated as mini-computers. In the event that the initial hardware installation becomes limited, it could be replaced with supplementary or additional hardware at relatively low cost to provide necessary growth.

Resource Requirements

Resource requirements are viewed from four standpoints - additional software, hardware, facilities and personnel directly relatable to TRADES.

Table 8-3 summarizes the relative software implications of each ACO, providing estimated costs and level of effect. It should be noted, however, that software requirements apply only to the actual system design, prototyping, and initial deployment of TRADES and absolute values are subject to revision in the light of lessons learned during the remaining TRADES Phase II effort.

TABLE 8-3. ACO COMPARISON - SOFTWARE COSTS

ACO	EST. DEVELOPMENT COST*	MAN-YEARS	
		DESIGN**	DEVELOPMENT**
PFDB	$400K	3.25	4
MTD	$350K	3.50	3.50
ADPE	$400K	3.25	4
SAMI	$400K	3.25	4
SAMF	$400K	3.25	4

*Current DBMS and software maintenance are sunk costs. Relative values are reasonably correct. Design/Development based on very preliminary estimate of approx. 10,000 lines at $40/line.

**Based on system design effort (man-months) per module:

Exec. Program	- 1	Interface Module (15 data systems)	- 30
Source Ident.	- 1	Management Module	- 5
Quick Response	- 1	Stat./Anal.Module	- 1

Development of the source identification module will constitute a major initial effort of TRADES, and will be an ongoing requirement throughout its life. During its initial deployment, TRADES could be limited to certain commodity areas, or selected data sources. Ultimately, it must include all commodities and sources, as well as be maintained on a regular date routine.

Table 8-2 summarized the hardware requirements for each ACO. Table 8-4 summarizes the costs associated with additional hardware that must be purchased for implementation of TRADES. The computers and peripheral equipment available at OAD and the DPFO are sunk costs. Additional procurements are limited to terminals, multiplexers and line printers for RAM/ILS and the users. An annual operating cost is included for one additional dedicated commo line from RAM/ILS to the TRADES computer. All other maintenance costs are assumed absorbed in the present OAD budget.

The additional facilities attributable to TRADES are limited to the requirements of the additional personnel. As shown in Table 8-5, each person is provided a standard work space - 100 ft.^{2} with a desk and file cabinet. The clerk typist is furnished a work station (which includes the desk and associated typist equipment).

All ACOs are similar other than the PFDB and ADPE, each of which require one additional person assigned to OAD on an "if required" basis for interface activities. Based on the number and grade structure of additional personnel required, Table 8-6 compares personnel costs for each ACO. These costs are based on 1981 salaries plus 20% for overhead.

The total resources (cost) differences between the ACOs are presented in Table 8-7. From these results, it is seen that there is less than a 10% difference in development costs and less than 15% difference in annual operating cost. Based on the potential saving that can be accrued by providing reliable RAM data to the TRADOC community, these differences become insignificant.

TABLE 8-4. ACO COMPARISON - HARDWARE COSTS*

	HARDWARE COSTS -- INITIAL**				HARDWARE COSTS - ANNUAL OPERATING			
ACO	RAM/ILS	OAD	DPFO	USERS	RAM/ILS	OAD	DPFO	USERS
PFDB	$16,750[a] -$20,700	$8,370	0	$167,500[a] -$207,000	$720	0	0	0
MTD	$16,750 -$20,700	0	0	$167,500[a] -$207,000	$10,800[b]	0	0	0
ADPE	$16,750 -$20,700	$8,370	0	$167,500[a] -$207,000	$720	0	0	0
SAMI	$16,750 -$20,700	$8,370	0	$167,500[a] -$207,000	$720	0	0	0
SAMF	$16,750 -$20,700	0	0	$167,500[a] -$207,000	$10,800[b]	0	0	0

*Values are not rounded to provide a consistent audit trail.
**All other hardware cost considered as sunk costs; now available.

[a]Lower value-Interactive terminal w/line printer & multiplexer; upper value-TRS-80/Apple type computer w/printer & multiplexer.

[b]Dedicated line.

NOTE: Because the purpose of the report is to select from alternative concepts of operation, costing is confined to differences between the respective ACOs. Total costing must be addressed in the subsequent economic analysis.

TABLE 8-5. ACO COMPARISON - FACILITIES COSTS

ACO	FACILITIES	FACILITIES COST*	
		INITIAL INVEST.	ANNUAL COST
PFDB	700 ft^2 Work Space	0	$1,561
	7 Desks	$1,400	0
	7 Secure File Cabinets	$21,600	0
	2 Typing Stations	$4,000	0
MTD	600 ft^2 Work Space	0	$1,338
	6 Desks	$1,200	0
	6 Secure File Cabinets	$14,800	0
	2 Typing Stations	$4,000	0
ADPE	(Same as PFDB)	(Same as PFDB)	
SAMI	(Same as MTD)	(Same as MTD)	
SAMF	(Same as MTD)	(Same as MTD)	

*Based on Army planning factors of:
$2.23/$ft^2$ annual maintenance cost for work space;
100 ft^2 required per person; $200 per desk; $2,800 per secure file cabinet; $2,000 per typewriter with desk and accessory equipment.

TABLE 8-6. ACO COMPARISON - PERSONNEL COSTS

ACO	NUMBER OF PERSONNEL		ANNUAL PERSONNEL COSTS	
	RAM/ILS	OAD	RAM/ILS	OAD
PFDB	6	(4) + 1*	$200,000**	$36,700[a]
MTD	6	(4)	$200,000**	0
ADPE	6	(4) + 1*	$200,000**	$36,700[a]
SAMI	6	(4)	$200,000**	0
SAMF	6	(4)	$200,000**	0

*Individual is "if required" for interface activities
**Based on 1981 pay scale + 20% overhead:
3-GS-13
1-GS-12
1-GS-11
1-GS-04

[a]Based on 1981 pay scale for one GS-12 + 20% overhead increment.

See also NOTE on Table 8-4, Page 8-9

TABLE 8-7. COST* SUMMARY OF ALTERNATIVES
($000)

DEVELOPMENT	PFDB	MTD	ADPE	SAMI	SAMF
Software	$400.0	$350.0	$400.0	$400.0	$400.0
Facilities	27.0	20.0	27.0	20.0	20.0
Hardware	192.6	184.3	192.6	192.6	184.3
TOTAL	$619.6	$554.3	$619.6	$612.6	$604.3
OPERATING (ANNUAL)					
Personnel	$236.7	$200.0	$236.7	$200.0	$200.0
Facilities	1.5	1.3	1.5	1.3	1.3
Hardware	.7	10.8	.7	.7	10.8
TOTAL	$238.9	$212.1	$238.9	$202.0	$212.1

*1981 dollars; not rounded to preserve audit trail.

Implementation Time

To properly assess this EEA, certain fundamental assumptions must be accepted:

1. TRADES will be categorized as a Class IV ADP system per AR 18-1
2. The MTD and SAMF ACOs, if selected, will be designed to reside on the UNIVAC 1100 series ADP system at the TRADOC DPFO, Fort Leavenworth, Kansas
3. The PFDB, ADPE and SAMI ACOs, if selected, will be designed to reside on the OAD mini-computers planned for procurement and will have the DPFO available for backup for work overflow during peak work efforts
4. The primary responsibility for operational support of TRADES will be assigned to an existing division/branch of LOGC as an additional function.

In general, implementation time for the PFDB, ADPE, and stand-alone ACOs should be equivalent. Since development effort for all ACOs will be in excess of $100,000 (but under $3M), they fall within a Class IV ADP, require a product manager or project officer appointed by TRADOC, with system approval at TRADOC level.

In accordance with Table 8-8, TRADES should be implemented during calendar year (and fiscal year) '85. Rigid adherence to the approval and administrative cycles is required in order to provide the software developer adequate time to complete the process. Software development incorporates system designs to the DFSR level of detail programming, debugging, prototyping, and system demonstration.

TABLE 8-8. ACO COMPARISONS - IMPLEMENTATION SCHEDULES

LIFE CYCLE STAGE	MTD	PFDB, ADPE, SAMI, SAMF
ACO Final Report	4 Feb. 1982	4 Feb. 1982
TRADOC Approval (Class IV System)	1 Aug. 1982	1 Aug. 1982
Date of Contract - Software Development	1 March 1982	1 March 1982
System Design & Development Completion	1 Dec. 1984	1 March 1985

The difference in implementation time for MTD is attributable to a minor savings of programming, debugging, and prototyping.

CHAPTER IX

CONCLUSIONS

This chapter summarizes the results of the analyses and considerations presented in the earlier chapters of this report.

REQUIREMENT

The requirements of draft AR 702-3, setting forth TRADOC's responsibility to maintain a central activity for the proper statement and justification of RAM characteristics and materiel requirements documents, was a key consideration in structuring the respective elements of TRADES.

STRUCTURE & ENVIRONMENT

TRADES is seen as an information system serving the requirements of the RAM/ILS community of TRADOC as detailed in the SRD and approved by SAG. It is composed of functional elements supported by a structure of regulations, procedures, and mechanization to facilitate its activities. The functional organization is charged with the task of providing reference and tools for the analysis of RAM data to the weapon system, subsystem, and selected component levels.

The analysis of TRADES and its alternative concepts of operation considers the current organization and distribution of RAM functions within TRADOC to be stable and continuing. Thus, the RAM engineers in the boards, schools, and other user activities retain full and complete responsibility for what data they use and what they do with it. The TRADES function is to facilitate their efforts.

TRADES is seen as closely interfaced with the Army's evolving system for acquiring, structuring, and using RAM data. It must be created, grow, and function effectively through a significant evolution in data sources, principally in the materiel development test and acquisition communities. This implies the capability of addressing both hard copy and automated information. Initially, there is a heavy emphasis on hard copy from all levels, with a gradual shift over the next four to six years into mechanized and increasingly interconnected and automated information.

The basic concept of TRADES is essentially decentralized, i.e., the respective proponent activities and users retain responsibility for the quality and utilization of RAM data. The TRADES task is to facilitate their rapid access to a remunerative scope and detail of information, i.e., information which the user judges to be appropriate and adequate for him to do the job he is tasked to do.

As TRADES begins to function and facilitate the work of the users, demands will change in response to new capabilities. Therefore, the TRADES system is also evolutionary in the sense of elements and structure. New capabilities provide an improved potential to satisfy the RAM/ILS goals of an effective Army material system.

FUNCTIONS

In designing TRADES, our objective was to set out what had to be accomplished in all functional activities, i.e., mission and functions, scope and content of TRADES activity.

TRADES must identify sources, access them, and provide for their analysis in format(s) required by the TRADES RAM community. Additionally, a method must be provided for a "corporate memory" of results, quick response for applications which are severely time limited, as well as data for the management and growth of TRADES.

These are embodied in five basic modules detailed in Chapter II:

1. Source identification
2. Interface
3. Quick Response
4. Statistical/analytical
5. Management.

ORGANIZATION

The TRADES functional implementation implies the establishment of a branch within the RAM/ILS Division, with a Branch Chief responsible for planning, and two analysts with special expertise in reliability

and statistics, responsible for methodology development, analysis and special studies. These two spaces recognize the need for statistical and analytical skills "across-the-board" relating to the RAM area as specifically associated with TRADES.

Additionally required is a RAM engineer and a computer specialist to provide customer service, and the activities implied in the TRADES evolutionary concept of operation. A clerk/typist individual with background in data entry and extraction is also needed. This individual should have career development potential.

TRADES MECHANIZATION ACTIVITIES

The "alternative concepts of operation" relate to only one very significant phase, i.e., methods of computer mechanization.

The APJ approach takes maximum advantage of the availability of existing hardware and sunk costs, and requires only modest hardware necessary to provide access. Resources are thereby focussed on system development and implementation.

The method of evaluation was to hold the required capabilities roughly equal and measure the differing cost, time, and practicalities of implementation. Four major ACOs analyzed met the EEAs:

1. LOGC MTD System. This is an implemented computer system for establishing maintenance task demands. Only a few data elements were found to be common. Hence, the structure of functional modules for TRADES would have to be programmed from scratch and the only gain would be through joining an already established data system, i.e., the availability of established administrative and operating practices.

2. The Planning Factors Data Base is an approved concept now in the DFSR phase, with authority already provided to continue this development. PFDB is an "umbrella" which plans to utilize inputs from numerous logistical data systems to establish Army planning data. PFDB clearly and legitimately claims MTD as a module, and has an equal claim to the developed TRADES. This does not affect TRADOC's need to create the TRADES system, which then functions as a module of PFDB, in the same sense of any of its other sources.

3. The ADPE concept provides a structure to provide the LOGCEN with an on-site computer capability. As the master plan for ADPE, it is a part of the TRADES environment, i.e., any mechanization of TRADES must be consistent with the ADPE concept and structure. ADPE describes equipment potentials and has time-share capability in addition to its primary justification to serve LOGEX.

4. Stand-Alone TRADES. APJ examined two alternative mechanizations: the first is a concept structure based on the use of mini-computers (SAMI); an alternative is a stand-alone system based on a main frame (SAMF). Both concepts are fully consistent and compatible with PFDB and ADPE concepts. The first approach considers the utilization of the very substantial local mini-computer capability planned for installation at the LOGC. The second relies on the main frame at Fort Leavenworth DPFO. It is concluded that both branches of this last alternative would satisfy the TRADES mechanization requirement. Both are consistent with the ADPE plan and the PFDB process.

Cost and time differences among all the mechanization alternatives examined were found to be insignificant. The slight advantage of MTD was within the bounds of the estimation process.

We conclude that there are advantages to the common location of OAD and the TRADES functional activity, and there is substantial advantage to begin the implementation of TRADES with a mini-computer. Close access, particularly in the system design phases, is clearly essential, and the inputs of the users and of the RAM ILS Division are absolutely essential.

Nevertheless, it is also a requirement that the programs be "portable", i.e., that the programs and logic not be specific computer-peculiar or constrained.*

It is, therefore, concluded that implementation should focus on creating a TRADES system which will function as a PFDB module in a manner consistent with the overall ADPE plan.

IMPLEMENTATION

It is concluded that the evolutionary development of TRADES may most effectively be undertaken by taking steps to avoid the continued loss of RAM data, and to address the problems of hard copy retention, identification, assessment and organization. Further, that implementation of TRADES be initiated with a commodity area/activity which is a current major repository of RAM data so that the entire system may be exercised and lessons learned applied to create a successful TRADES.

With the completion of concept development, there will be sufficient information and structure for definition and design, system development and deployment, to proceed.

It is finally concluded that the PFDB ACO should be selected for the further development of TRADES. This choice was carefully considered and evaluated, in recognition of the fact that there were no significant differences among the ACOs. The operating procedures and response times to the users do not vary significantly from one ACO to another. It is APJ's conclusion that the state of system development of PFDB provides strong administrative advantages to the development and subsequent operation of the TRADES system.

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* We may note here a current major Navy data system which was operated on an Air Force computer, and which has recently been moved to an Army Computer Center based on considerations of operating economy and capability. That this action was feasible was because system design and programming took portability into account from the outset.

In the broadest sense, TRADES is indeed a planning factor, and will contain useful information, e.g., repair times, repair frequencies, and maintenance efforts to support a variety of combat development actions. These include such activities as MACRIT, Maintenance Manpower Logistics Analysis (MMLA), wargaming, and other simulations. Because of this, and a similar way of providing customer service, there is a great deal of compatibility between TRADES and PFDB. Thus, customer service is likely to be enhanced.

Later developmental actions in both management and software areas may likewise be facilitated, with some opportunities to conclude selected actions once, rather than simultaneously. Representative of this type of savings would be the selection of a DBMS which would be used by both systems. TRADES will also maximize "sunk costs" of equipment already envisioned for PFDB. However, since PFDB requirements have not been completely finalized, maximum consideration for and accommodation of TRADES requirements may be made.

The organizational structure of the LOGC provides a clear-cut division of responsibilities, using the PFDB ACO. The Materiel Directorate would retain functional proponency of TRADES, while the Operations Analysis Directorate would develop and operate the automated system. This is a clearly understood method of operation and is compatible with the current organizational responsibilities within the Logistics Center.

For these reasons, and those noted in the SRD as well as in earlier portions of the ACO, it is concluded that the PFDB alternative is both a logical and proper choice for continued development of TRADES.

CHAPTER X

RECOMMENDATIONS

The following recommendations are based on the approved SRD and on the conclusions set forth in Chapter IX.

1. That the TRADES concept development be completed and that succeeding steps relating to system definition and design, development, and deployment be undertaken
2. That a branch charged with the development and implementation of TRADES be created within the RAM/ILS Division with the functions and manning recommended in Chapter II
3. That the TRADES logical and modular structure be developed
4. That, in programming and implementation of TRADES, full advantage be taken of sunk costs by LOGC and TRADOC, i.e., utilize the administrative facilitation offered by the approval and implementation stage of PFDB. In the event that progress is delayed, recourse should be had to other approved systems
5. That the firm requirement be established that the TRADES system mechanization be portable, with capability for installation with minimum change on the 1984 generation of computers available to the Army, either directly or through inter-Service agreements
6. That in parallel with TRADES mechanization activities, effort involving source identification and hard copy operations, be initiated. Actions should be taken to inventory, identify, assess, and render accessible hard copy information within the TRADOC community
7. That a planned implementation date of early 1985 for the developed TRADES system be adopted
8. That an Army regulation be prepared to formalize TRADES in the Army structure.
9. That a parallel effort within TRADOC be implemented to initiate a standardized data collection system which will provide computerized data for use in TRADES.

GLOSSARY

ACO	Alternative Concept of Operation
ADPE	Automatic Data Processing Equipment
AMDF	Army Master Data File
APJ	American Power Jet Company
CRT	Cathode Ray Tube
DFSR	Detailed Functional System Requirements
DLSIE	Defense Logistics Studies Information Exchange
DPFO	Data Processing Field Office
DTIC	Defense Technical Information Center
EEA	Essential Elements of Analysis
EEI	Essential Elements of Information
FSR	Final Study Report
LIF	Logistics Intelligence File
LOGEX	Logistics Exercise
LSAR	Logistics Support Analysis Report
MACRIT	Manpower Authorization Standards & Criteria
MTBF	Mean Time Between Failures
MTBOMF	Mean Time Between Operational Mission Failures
MTBUMA	Mean Time Between Unscheduled Maintenance Actions
MTD	Maintenance Task Demand
MTTR	Mean Time to Repair
OAD	Operations Analysis Directorate
OTEA	(US) Army Operational Test & Evaluation Agency
PFDB	Planning Factors Data Base
PFMD	Planning Factors Management Division
RAM	Reliability, Availability, Maintainability
SACS	Structure and Composition System
SAG	Study Advisory Group
SAMS	Standard Army Maintenance System
SDC	Sample Data Collection
SOW	Statement of Work
SRD	System Requirements Description
STP	System Technical Paper
SWP	Study Work Plan

GLOSSARY (Concluded)

TECOM	(US) Army Test and Evaluation Command
TO&E	Table of Organization & Equipment
TRADES	TRADOC RAM Data Evaluation Study
TRADOC	(US) Army Training and Doctrine Command
TSM	TRADOC System Manager


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